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ABSTRACT

The distribution of measured reading achievement in a population of 3,651 sixth-grade students and the relationship of reading deficiency to later achievement and behavior in secondary schools were reported. Reading deficiency was defined as a discrepancy between the level of reading ability expected on the basis of a subject's total mental ability as measured by the California Test of Mental Maturity and the level of actual performance as indicated by the California Achievement Test total reading score. Both tests were administered in the sixth grade during the 1954-55 school year. The discrepancy score was used to define three groups of students: underachievers; average achievers; and overachievers. These groups were compared on concurrent measures of performance, later academic performance, and later behavior and outcome. Underachievers in reading, as a group, were found significantly lower in performance than average or underachievers in other scholastic areas in the sixth grade, and over the subsequent secondary school grades these results were consistent on ratings of performance reflected in grade point averages and on objective test measures. No significant later behavioral differences were noted across groups. Underachievers had the highest attrition rate. Tables, graphs, and references are included. (Author/WB)

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Reading Achievement and Its Relationship to Academic Performance

Part I:

Reading Deficiency in Elementary School and Relationships to Secondary School Performance

Dee Norman Lloyd

U. S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
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Summary

This report presents the distribution of measured reading achievement in a population of 3651 sixth grade students and the relationship of reading deficiency to later achievement and behavior in secondary school.

Reading deficiency was defined in terms of a discrepancy between the level of reading ability that was expected on the basis of a subject's total mental ability and level of actual performance measured for the subject. An expected reading score was obtained for each subject by applying the regression coefficients for predicting the California Achievement Test Total Reading score from the IQ score of the California Test of Mental Maturity. Both of these tests were administered in the 6th grade in the 1954-55 school year. The expected reading score was then subtracted from the obtained reading score to produce a discrepancy score. The distribution of the discrepancy score, by virtue of its derivation, had a mean of zero and a standard deviation equal to the standard error of estimate for predicting the CAT Reading score from the CTMM IQ score. Two levels of underachievement were used to measure the extent of reading deficiency, a score below one standard error of estimate and a score below one and one-half standard error of estimate. (In a normalized distribution these levels are equivalent to a subject's reading two stanines and three stanines below the reading score expected

on the basis of mental ability.) The probability that scores would exceed these two levels because of errors of measurement was determined to be .043 and .005, respectively.

In order to investigate the relationship of underachievement in reading to later performance and behavior, the discrepancy score was used to define three groups of students: underachievers (discrepancy scores below one standard error of estimate), average achievers (discrepancy scores between plus and minus one standard error of estimate), and overachievers (discrepancy scores above one standard error of estimate). These groups were compared on concurrent measures of performance, later academic performance, and later behavior and outcome. The measures of concurrent performance included course marks in the various 6th grade courses and performance on other subtests of the CAT Battery (language and arithmetic). Measures of later academic performance were grade point averages from grades 7 through 12, grade point averages in specific course areas averaged over the years in which a subject was in school, number of retentions in secondary school, and performance on standardized tests administered in the 7th and 9th grades. Behavioral measures were the amount of participation in school activities in grades 7 through 10, the amount of absence in grades 7 through 12, and scores on the Cornell Index in the 11th grade. Outcome measures were the secondary school dropout rate and work obtained or college attended after high school graduation.

The percentage of subjects found to be reading one standard error of estimate or more below the expected reading level was 14.7. Taking into account that 4.3% of the subjects might have had discrepancy scores of this magnitude purely from the errors of measurement in the tests, reading deficiency was estimated to be characteristic of 10 to 15 out of 100 of the 6th grade students. In this reading deficiency group were 183 students, or 5% of the study sample, who were reading one and one-half standard error of estimate (1.3 grade equivalents) below the level expected from their mental ability score. The occurrence of reading deficiency below one standard error of estimate was found to be approximately the same for all levels of mental ability. At the level of one and one-half standard error of estimate below expected reading level, there was a higher percentage of reading deficiency for students with an IQ score above 100 (5.9%) than for those with IQs below 100 (3.8%), suggesting that although reading deficiency is no more prevalent among students of higher mental ability, when a deficiency exists it is more likely to be greater.

The reading levels of the three achievement groups were compared in the 7th and 9th grades. In both grades, underachievers had a mean reading score that was below grade placement and significantly below the mean score of average achievers. In order to determine whether any of the underachievers overcame their reading deficiency in later grades, reading levels in the 7th and 9th grades were compared to an expected level projected from the

6th grade expected reading score. By this method of estimation, the number of underachievers who were found to have improved to their expected reading level was less than the estimated measurement error in the classification of underachievers. This finding was further indication of the persisting status of reading deficiency and suggested that only in exceptional cases did underachievers in the 6th grade overcome their deficiency in secondary school.

Because reading is a basic skill, efficiency in reading would be expected to affect achievement in other skill areas in the educational process. The investigation of the relationships of reading achievement to measures of achievement in other areas both in the 6th grade and through secondary school years was directed at determining (1) the extent of the effect of underachievement in reading on performance in other skill areas and (2) the areas that do not depend upon reading skills for higher performance, that is, areas where the underachievers in reading perform as well as or better than average or overachievers.

Underachievers in reading, as a group, were found significantly lower in performance than average or overachievers in other scholastic areas in the 6th grade and over the subsequent secondary school grades. These results were consistent on both ratings of performance, reflected in grade point averages, and on objective test measures. Underachievement in reading was predictive of low academic performance in all subject areas of educational development and in all years of secondary school.

Comparison of the relative performance of underachievers in different areas also provided consistent results. On both standardized tests and grade point averages, underachievers performed better (were least deficient) in the areas of mathematics and science and performed least well in areas more closely related to reading skills, i.e., literature, language skills, vocabulary, and social studies.

On all the measures of later behavior and adjustment, no significant differences were found across the achievement groups. The only consistent trend across secondary school years was in the amount of participation in school activities. A consistently higher percentage of underachievers had no participation in school activities indicated on their secondary school records. Although more underachievers may have been isolates or nonparticipants in school activities, this was not seen as strongly characteristic of this group.

In the level of education attained, there was a higher attrition among underachievers in secondary school and beyond high school. Of the total number of 6th grade dropouts and graduates (excluding students who transferred out of the school system), 73% graduated from high school. In comparison, only 68% of the underachievers graduated. From the information available on graduates, it was estimated that 55% of the original group of dropouts and graduates continued training beyond high school, whereas only 37% of the underachievers continued training. For

graduates continuing their education, a higher percentage of underachievers than average achievers entered business or technical schools in contrast to colleges or universities; however, the difference was not statistically significant. For graduates entering the world of work, there was not a significant difference in the type of work obtained by underachievers and average achievers.

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Reading Deficiency in Elementary School and Relationships to Secondary School Performance[1]

Dee Norman Lloyd[2]

This report presents an analysis of data in Project MHSC-1, Antecedents of Educational Achievement, related to the distribution of measured reading achievement in a population of 6th grade students and the relationship of reading deficiency to later achievement and behavior. The data on this study population is singularly suited to provide information on both incidence and later relationships. First, the study population consisted of the entire 6th grade class in a county school system, providing an adequately large sample to estimate the instance of reading deficiency in the general population. Second, this group of students was followed to their transfer, dropout, or graduation from secondary school. Therefore, effects of reading deficiency evident in the last year of elementary school could be related to later achievement and adjustment over a six-year period.

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[1]Portions of this study were undertaken in response to a request from the Secretary's (HEW) National Advisory Committee on Dyslexia and Related Reading Disorders for Technical data concerning the incidence and effects of reading disability.

[2]The author is director of Project MHSC-1, Antecedents of Educational Achievement, of which this study is a part. Appreciation is expressed to the many who have contributed to the project in the collection and coding of the data. Special appreciation is expressed to Mrs. Anita Green, Project Statistical Assistant, Miss Janet Modery, Project Secretary, and Mr. Michael Gold, Project Clerk, for their contributions to the present study. We also wish to thank the personnel of the County Board of Education who have contributed so much to making the project possible.

In addition, for some graduates, follow-up information on employment or college attendance after graduation was available for analysis.

Reading deficiency in this study was defined in terms of discrepancy between level of reading ability expected on the basis of a subject's total mental ability and level of actual performance measured for the subject. Defined in this way, reading deficiency can occur at any level of mental ability, and the relationships of reading deficiency to later performance that are not attributable to mental ability can be explored.[3]

In this part of the report, 6th grade data and information available in subsequent secondary school years were analyzed for the study population as a whole. The additional parts of this report will focus on some of the etiological factors involved in reading deficiency and analyses of the differences in the effects of reading deficiency that occur in different socio-economic, race, and sex groups.

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[3] Analysis of preliminary data on the prevalence of reading deficiency in this study population was reported previously in Newbrough, J. R. and Kelly, James G., "A Study of Reading Achievement in a Population of School Children," (In) Money, John (Editor), Reading Disability Progress and Research Needs in Dyslexia. Baltimore: Johns Hopkins Press, 1962. This data was reported in terms of the distribution of grade equivalent scores and used performance of two grades below grade placement as the criterion for reading retardation. Other data taken from the same county school system and many of the germinal ideas resulting in Project MHSC-1 were reported in Miller, A. D., Margolin, J. B., and Yolles, S. F., Epidemiology of Reading Disabilities; Some Methodologic Considerations and Early Findings, American Journal of Public Health, 1957, 47, pp. 1250-56.

Method

Subjects

Subjects were drawn from the study cohort of 4075 sixth grade students, the entire regular enrollment of the 6th grade in a county school system in 1954. These subjects were followed to their transfer, withdrawal, or graduation from high school. Of the 85 elementary schools involved in the study, 67 were attended predominantly by white children, 18 by Negro children. The county from which the study subjects were drawn is located in a Middle Atlantic state. The county is part of a metropolitan area, containing a portion of the central city's suburbs; however, it also contains areas that are classed as rural. The county is one of the 22 most rapidly growing counties in the United States, having a population that increased from 194,182 in 1950 to 357,395 in 1960. The county has a greater proportion of people under 45 years of age and a higher median income and occupation level than that of the population of the United States taken as a whole (Goldsmith & Stockwell, 1965).

Subjects included in this analysis were the 3651 students for whom scores on both the reading test and intelligence test used to define reading deficiency were available. This was 90% of the total cohort. Some subjects had one but not both scores. The general distributions reported for the reading score and mental ability score were based on the total number of subjects with scores available on each test.

For data on the relationships of the reading achievement in the 6th grade to later measures of achievement and behavior, the number of subjects varied because of the loss of subjects over subsequent years through transfer or dropout as well as from missing information in later records. Analyses on the relationship to dropout were limited to subjects known to have dropped out or graduated, eliminating transfers, whose ultimate outcome was indeterminate.

Variables

The primary independent variable in the study was a discrepancy score that represented the difference between a subject's expected reading level and the level reflected in his obtained reading test score. The expected reading level was derived from the IQ score of the California Test of Mental Maturity (CTMM IQ score), 1950 edition, administered between the second and fifth months of the 1954-55 school year. The obtained reading level was the California Achievement Test Total Reading Score (CAT Reading score) expressed in grade equivalents. The reading test was administered with the complete CAT Battery in the second to fifth month of the 1954-55 school year.

The discrepancy score indicated the deviation of a subject's reading performance from the performance that would be expected on the basis of his CTMM IQ score. If a subject was reading at the predicted level, this score was zero; if his level was lower than predicted, his score was negative,indicating underachievement; if the level was higher than predicted, the score was positive, indicating overachievement in reading. This score was also in grade equivalent units.

The dependent variables for investigating the relationship of reading deficiency to later performance and behavior can be classified in three categories: concurrent performance, later academic performance, later behavior and outcome. The measures of concurrent performance included course marks in the various 6th grade courses and performance on other subtests of the CAT Battery (language and arithmetic). Measures of later academic performance consisted of grade point averages from grades 7 through 12, grade point averages in specific course areas averaged over the years in which a subject was in school, and performance on standardized tests administered in the 7th and 9th grades (Stanford Achievement Test and Iowa Test of Educational Development). Behavioral and outcome measures were the number of school activities participated in for grades 7 through 10, the number of absences in grades 7 through 12,. scores on the Cornell Index in the 11th grade, dropout or graduation from high school, work level obtained after graduation, and college attendance following graduation.

Specific descriptions of these variables are given in connection with the results of the analyses.

Procedures

Derivation of the discrepancy score. An expected reading score was obtained for each subject by applying regression coefficients to his CTMM IQ score. This score was then subtracted from the subject's CAT Reading score to produce a difference score for each subject. The distribution of the difference score, by virtue of its derivation, had a mean of zero and a standard deviation equal to the

standard error of estimate for predicting the CAT Reading score from the CTMM IQ score. The obtained standard error of estimate was .868, indicating that approximately two thirds of the actual reading scores lay within the limits of plus and minus approximately .9 of a grade equivalent score from the predicted reading score.[4]

Limits for defining reading deficiency. Two levels of underachievement were used to determine the amount of reading deficiency in the study population. The first level was a discrepancy between obtained and expected reading greater than one standard error of estimate (below 1 S.E.E.). The second level was a discrepancy greater than one and one-half standard error of estimate (below 1½ S.E.E.). These levels also can be expressed in two other commonly used units for describing achievement. First, in a normalized distribution, the levels are equivalent to a reading score more than two stanines and three stanines below the score expected on the basis of mental ability. Second, in grade equivalent units, the levels included students who were reading .9 grades and 1.3 grades below the grade level expected from their mental ability score. Discrepancies of this size would seem sufficiently large to have resulted from an

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[4]All data, except for the discrepancy score created for this analysis, were previously coded, verified, and transferred onto magnetic computer tape. The data have been used in several analyses over the past four years, which have provided additional validation of the accuracy of the coded information. The derivation of the discrepancy score and analyses for this study were computed by means of the IBM 360 computer at the National Institutes of Health computer facility. Appreciation is expressed to Mr. Stuart Teper, of the National Institute of Mental Health Computer Systems Branch for his assistance in programing and supervising the computer analyses.

actual deficiency rather than from inconsistencies in the subject's performance or other factors that affect the reliability of the test scores (errors of measurement). In order to estimate what confidence could be placed in these levels for judging true reading deficiency, the standard deviation of difference arising from errors of measurement was calculated from a formula given by Thorndike (1963). This statistic was derived from the reliability coefficients of the predictor (CTMM IQ score) and criterion (CAT Reading score) measures and the correlation between the predictor and criterion. For the former, the reliabilities given by the California Test Bureau for the CAT Reading score (.94) and the CTMM (.92) were used. The latter was the correlation of these tests in the study population (.81).[5]

The standard deviation due to errors of measurement using these coefficients was .505. This indicated that only 4.3% of subjects would be expected to have discrepancy scores below 1 S.E.E. (.868) due to errors of measurement. Scores below 1½ S.E.E. (1.30) would be expected to occur on the basis of errors in measurement in only

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[5]The lower of the reported reliabilities for the CTMM and the CAT Reading score were used in the calculations. Also, it should be noted that the correlation in the study population is higher than that typically found between achievement test measures and IQ measures and higher than the studies reported by the California Test Bureau. (These are typically around .70.) Both of these differences in the size of correlations would result in a more conservative estimate of measurement error, i.e., the standard deviation due to errors of measurement would be larger.

0.5% of the cases (there would be an equal expectation of misclassification of subjects in the direction of overachievement because of errors in measurement).

The relationship of over-, average and underachievement in reading to later performance. In order to investigate the relationship of achievement in reading to later performance and behavior, the discrepancy score was used to define three groups of students: underachievers (discrepancy scores below 1 S.E.E.), average achievers (discrepancy scores between plus and minus 1 S.E.E.),and overachievers (discrepancy scores above 1 S.E.E.). Relationships of variables to reading achievement were assessed by cross-tabulation and analysis of variance across the three achievement groups, with respective chi square and F tests for significant differences.

Because of the ease with which statistically significant differences can be obtained in large samples, indices of association were also calculated to evaluate (1) the degree to which achievement groups differed on variables and (2) the relative strength of relationships to the achievement classification of different variables. In connection with analysis of variance comparisons, the index of association was the omega^2 statistic, expressed as the percentage of variance among the achievement groups accounted for by a particular variable.[6]

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[6] For a discussion of this statistic, see Hayes (1963). The formula used to estimate omega^2 was:

$$\text{est. omega}^2 = \frac{\text{SS between} - (g - 1)\ \text{MS within}}{\text{SS total} + \text{MS within}}.$$

For chi square comparisons, the index of association was the contingency coefficient.[7]

Results

General Distribution of Reading and IQ Scores

The mean CTMM IQ score for the 3888 subjects with IQ scores was 102.00, with a standard deviation of 17.02. The 3651 subjects included in the analysis (having both IQ and reading scores) had a distribution with a mean of 101.96 and a standard deviation of 17.13. The minimal difference indicated that there was no bias introduced by the elimination of subjects having only one score. It should be noted, however, that the standard deviation of the study population was somewhat larger than that of the standardization sample, which was 16.0. The mean CAT Reading score for the 3892 subjects having this score was 5.80, with a standard deviation of 1.52. For the 3651 subjects having both reading and IQ scores, the mean was 5.83, with a standard deviation of 1.51. Differences again were minimal. The mean reading score for the study population was below the 50th percentile for the standardization norm group (6.1.).

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[7]Cross-tabulations were done within each of the four race-by-sex subsamples. Data for the total study population reported in this part of the study were obtained by summation across the four subsamples. Chi squares were not calculated for the total sample, but their significance level could be accurately determined from the levels of significance in the individual samples. Contingency coefficients will not be reported in this part of the study.

The percentages of CAT Reading scores in the standardization norm centile categories are presented in Table 1. In this distribution, underachievement in reading in the study population is given in absolute terms, i.e., in relation to grade placement and without differences in mental ability controlled. Of the 3892 sixth grade students (all who had reading scores), 28.2% were reading below the 20th percentile (1.2 grades below grade placement), and 15.2% were reading below the 10th percentile (2 grade levels below the norm).

The justification for using regression constants to establish the expected level of reading performance from the IQ score rested on two assumptions being met: (1) that the IQ and reading variables were linearly related (i.e., that the mean reading score for subjects at each IQ level lay on a straight line), and (2) that the variability of scores around the mean at each level of mental ability was approximately the same. Meeting the latter assumption was necessary in order to justify the use of one measure of variation (the standard error of estimate) to define reading deficiency across all levels of mental ability. As far as statistical probability is concerned, these two assumptions were met in the study population. The relationship of the CAT Reading score and the CTMM IQ score is shown in Table 2 and Figure 1, where the mean and standard deviation of reading scores at each stanine level of mental ability are given. In the Figure, where the regression line and standard error of estimate are also shown, the strong linear relationship of the two measures and the homogeneity of variance in reading scores across the CTMM IQ score categories can

Table 1

Distribution of the CAT Total Reading Score in Percentile and Grade Equivalent Categories for 3892 6th Grade Students[a]

Grade Equivalent / Percentile	1.0-4.1 0-9	4.2-4.9 10-19	5.0-5.4 20-29	5.5-5.7 30-39	5.8-6.0 40-49	6.1-6.4 50-59	6.5-6.8 60-69	6.9-7.3 70-79	7.4-7.8 80-89	7.9-9.9 90-99	Total
N	593	508	532	301	294	343	349	362	247	363	3892
%	15.2	13.0	13.7	9.7	7.6	8.8	9.0	9.3	6.4	9.3	100.0

[a]Percentiles and grade equivalents from standardization norms. Manual, California Achievement Tests. Elementary Battery, 1950 edition. Los Angeles: California Test Bureau, 1951.

Table 2

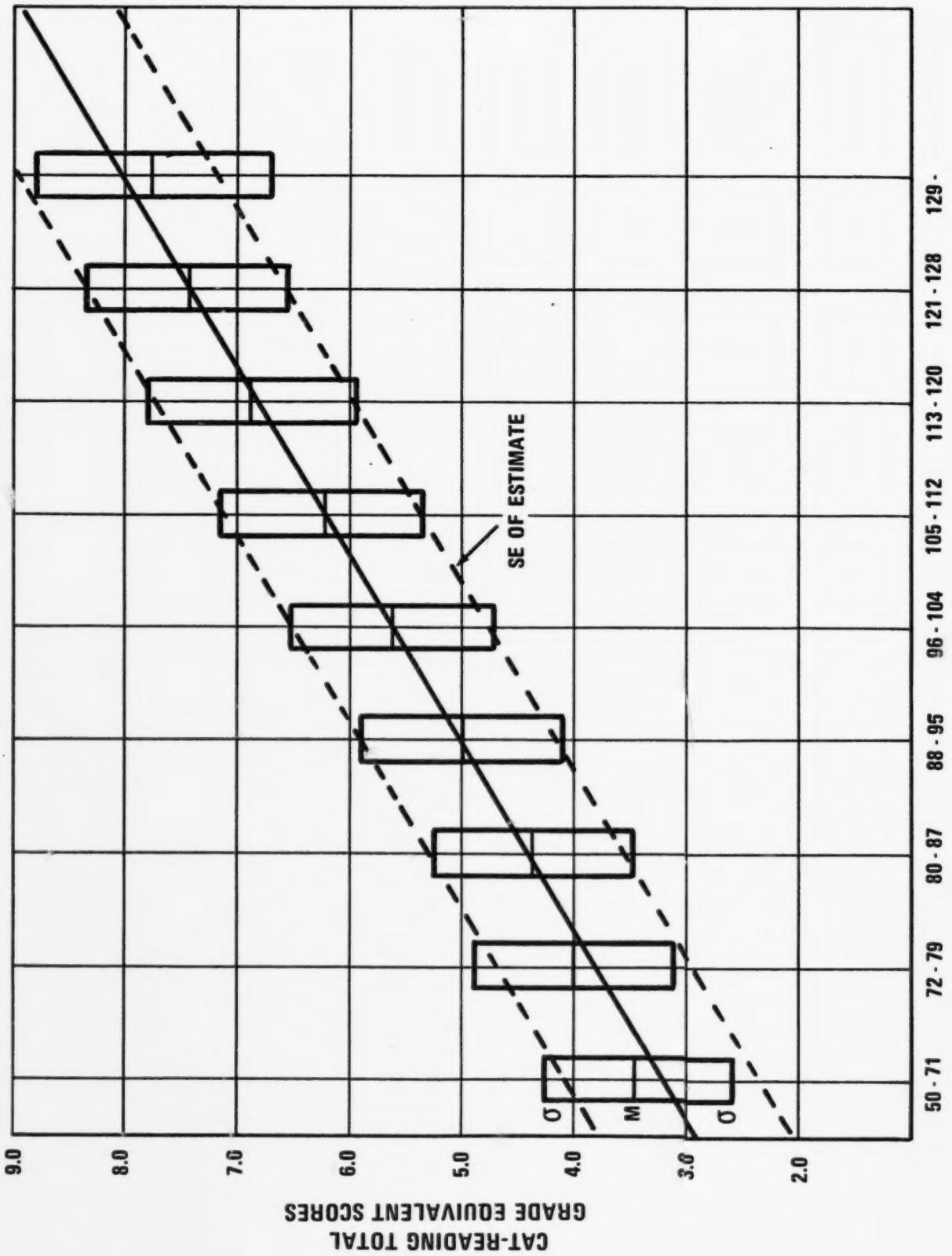
Means and Standard Deviations of CAT Total Reading Grade Equivalent Scores at Different Levels of Mental Ability (CTMM IQ Score)[a]

IQ	50-71	72-79	80-87	88-95	96-104	105-112	113-120	121-128	129-	Total
N	165	199	350	492	714	669	545	339	178	3651
M	3.44	4.01	4.36	4.98	5.62	6.22	6.89	7.46	8.26	5.83
S.D.	.83	.89	.89	.90	.90	.89	.92	.89	1.03	1.51

[a]IQ scores in stanine intervals based on standardization sample mean of 100 and standard deviation of 16. Manual, California Short-Form Test of Mental Maturity. Los Angeles: California Test Bureau, 1950.

FIGURE 1

MEAN AND STANDARD DEVIATION OF READING SCORES FOR LEVELS OF MENTAL ABILITY (N=3651)



be seen. There was only a slight regression effect in the extreme categories (tendency of errors of measurements to be downward at the top level and upward at the lowest level). The only differences in variability of note were in the extreme IQ categories, with slightly more variance in reading scores above an IQ score of 129 and slightly less variability below an IQ score of 71. As can be seen in Figure 1, the S.E.E. closely approximated the variances at each IQ level. The deviations in the extreme categories indicated that a slightly greater percentage of subjects with IQs above 120 would be classified as underachievers, and a slightly greater percentage of subjects with IQs below 80 would be classified as overachievers by using the S.E.E. to classify achievement groups.

Percentage of Reading Deficiency

Table 3 presents the number and percentage of subjects in the three categories of the discrepancy score representing under-, average, and overachievement in relation to expected reading level. The percentage of subjects reading 1 S.E.E. (two stanines) or more below their expected reading level was 14.7%. Taking into account that 4.3% of the subjects might have had discrepancy scores of this magnitude purely from the errors of measurement in the tests, reading deficiency would be estimated to be found in 10 to 15 out of 100 sixth grade students. Of the 536 students classified as underachievers, 183 or 5.0% of the study population were reading 1½ S.E.E. or more below their expected reading level; 67 students, 1.8% of the study population, were reading 2 S.E.E. below their expected level. In

Table 3

Number and Percentage of Subjects in Categories of Discrepancy
Between Expected and Obtained Reading Scores (N=3651)

Reading Deficiency Levels				Average		Overachievers	
Below 1½ S.E.E.[a]		Below 1 S.E.E.		-1 S.E. to + 1 S.E.E.		Above 1 S.E.E.	
N	%	N	%	N	%	N	%
183	5.0	536	14.7	2537	69.5	578	15.8

[a]Figure included in below 1 S.E.E. level.

terms of grade equivalent scores, these levels of reading deficiency represent subjects reading .9, 1.3, and 1.7 or more grade units below their expected level.

The percentage of overachievers in reading in the sample (reading .9 or more grades above their expected reading level) was as high as the percentage of underachievers.

Reading Deficiency at Different Levels of Mental Ability

Since a discrepancy score is uncorrelated with the measure from which it is derived, it was equally likely at all levels of mental ability for a subject to have a discrepancy score large enough to classify him in the deficiency category. Therefore, it was possible to compare the discrepancy scores and the IQ scores to determine whether reading deficiency was more prevalent in a particular IQ range.

Table 4 shows the number and percentage of subjects with reading deficiency at different levels of mental ability. Except for the IQ range below 70, the percentage of reading deficiency below 1 S.E.E. was approximately the same across all IQ levels. At the level of 1½ S.E.E. (3 stanines below expected reading level), the pattern of deficiency across IQ levels was different. There was a higher percentage of reading deficiency for students with an IQ above 100 (5.9%) than for those with an IQ below 100 (3.8%). This suggested that although reading deficiency is no more prevalent among students of higher mental ability, when a deficiency exists, it is more likely to be greater.

Table 4

Percentage of Reading Deficiency at Different Levels of Mental Ability

Deficiency Level	CTMM IQ Score													
	70 & below (N=150)		71-85 (N=461)		86-100 (N=981)		101-116 (N=1287)		117-132 (N=686)		133 & above (N=86)		Total (N=3651)	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Below 1 S.E.E.	6	4.0	71	15.4	149	15.2	201	15.6	97	14.1	12	13.9	536	14.7
Below 1½ S.E.E.	1	0.7	16	3.5	44	4.5	76	5.9	38	5.5	8	9.3	183	5.0

The distribution of obtained reading scores for the subjects in the deficiency group provided another finding related to the prevalence of greater deficiency at higher IQ levels. In the deficiency group, 93 (17.4%) of the students had IQ scores above 120 and could have been both reading above the 50th percentile and classified in the deficiency group. Only 51 (9.5%), however, had obtained reading scores above the 50th percentile.

Measurement of Reading Levels in Grades 7 and 9

Standardized tests of reading achievement were administered in the second month of the 7th grade and in the sixth to eighth month of the 9th grade. The test was part of the Stanford Achievement Test (SAT), advanced partial battery, Form J, 1953 edition. The SAT Reading Average score was coded in grade equivalent units. In order to assess the extent to which reading deficiency persists, the performance of under-, average, and overachievers in reading, as defined by the discrepancy score, was compared over the three testings. A comparison of absolute change between the 6th grade and 7th grade testings was not possible because the tests were different and the SAT employed a different type of norm group than the CAT.[8] It was possible, however, to compare the relative placement of the three achievement groups on these two tests. The 7th

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[8] The SAT norms were "modal-age" norms, that is, based only on students with typical age for a respective grade. For the project, the total-grade norms were obtained for the Stanford Achievement Test because it was thought that these norms would be more comparable to those of the California Achievement Test.

and 9th grade scores were from the same test and therefore could be directly compared.

The results of the comparison are presented in Table 5. Mean differences across the achievement groups were significant at all three testings, with underachievers reading below grade-placement and below average achievers in each grade. In order to compare the performance of the achievement groups in relation to the norm grade of placement, the mean score of each group was expressed in terms of the deviation in grade-equivalent units from the norm grade level for the time of testing. (See Figure 2.) For the Stanford Achievement Test, the deviation from both the "total-grade" and "modal-age" norms were calculated. From the very slight change in performance of the largest group, the average achievers, it appeared that the modal-age norms of the SAT were more comparable to the CAT than the total-grade norms. In the relative level of performance from the 6th to 7th grade, the underachievers appeared to have gained somewhat, especially when the modal-age norms were used.[9] Because of possible differences in the two tests and type of norms, however, cautious interpretation should be made of the indication of improvement. Stronger evidence for the enduring status of reading deficiency was in the similarity in level of performance of the achievement groups

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[9]Some regression toward the mean, as seen in the lower mean of overachievers and higher mean of underachievers on testing in the 7th grade, would be expected on retest because the classification of the achievement groups in the 6th grade capitalized on measurement error toward the extremes.

Table 5

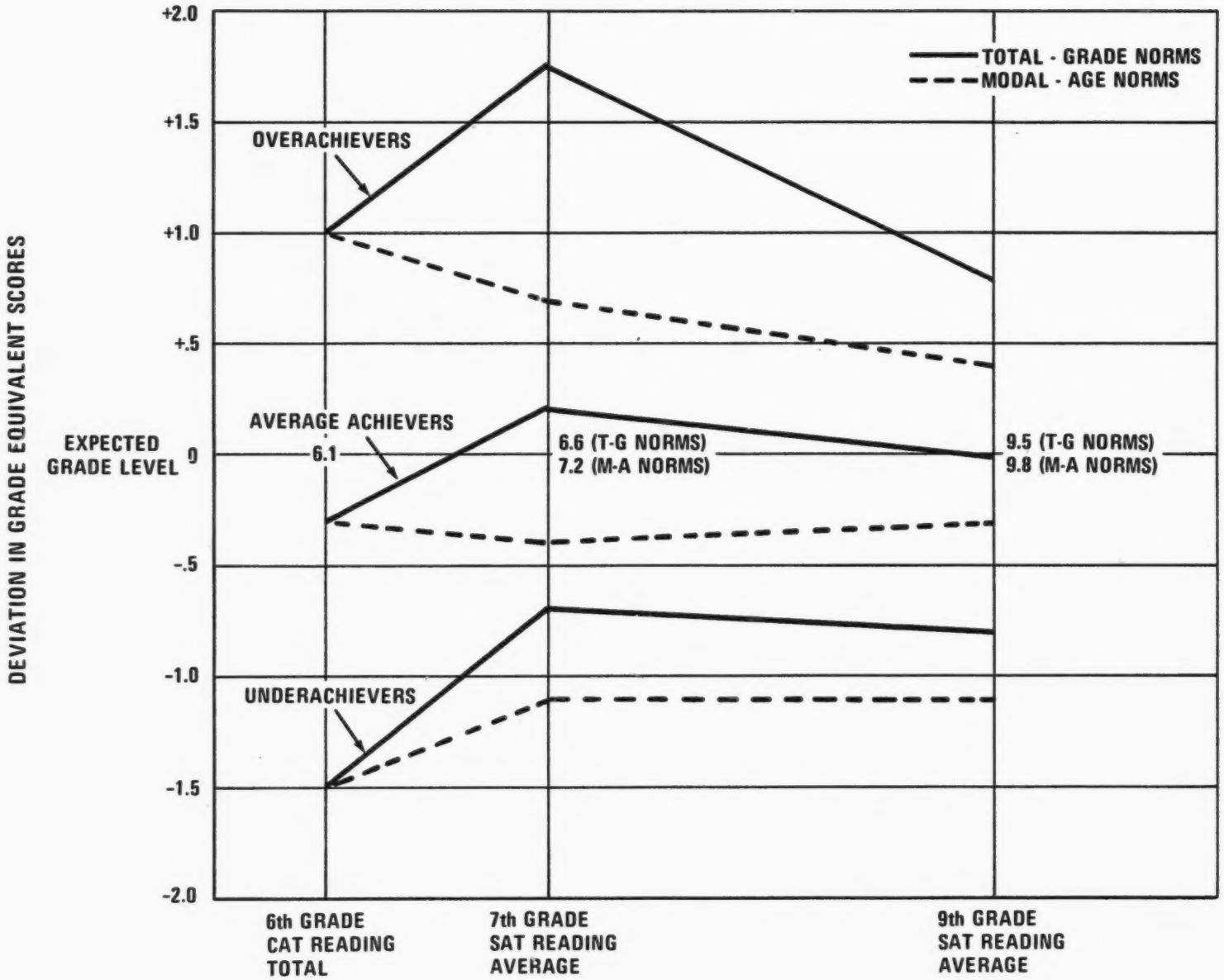
Mean Performance on Standardized Reading Tests at
Grades 6, 7, and 9 of
Under-, Average, and Overachievers in Reading

Test		Discrepancy Score Categories			F[a]	Omega[2]
		Underachievers	Average Achievers	Overachievers		
6th Grade CAT						
Total Reading	N	536	2537	578		
	M	4.6	5.8	7.1	520.4	22.2
	S.D.	1.2	1.3	1.5		
7th Grade SAT						
Reading Average	N	453	2180	483		
	M	5.9	6.8	7.9	112.4	6.7
	S.D.	1.8	2.1	2.2		
9th Grade SAT						
Reading Average	N	306	1449	320		
	M	8.7	9.5	10.3	44.6	4.0
	S.D.	2.1	2.0	2.0		

[a]All F's significant $p < .001$.

FIGURE 2

MEAN READING LEVEL OF UNDER-, AVERAGE, AND OVERACHIEVERS
CORRECTED FOR GRADE LEVEL



when tested on the same test battery in grades 7 and 9.

Although the underachievers as a group performed consistently lower than average achievers to grade 9, the decrease in percentage of variance across the achievement groups accounted for by the reading scores at the different grade levels (Table 5) suggested that some underachievers may have overcome their deficiency in reading and raised their performance to the level of average achievers. In order to determine whether this decrease in variance reflected a more homogeneous group (related to the attrition in number of scores) or whether a substantial number of underachievers had improved in reading level, additional cross-tabulations were prepared. The expected reading scores in the 6th grade, grouped into the norm centile intervals of the CAT Reading score, were contrasted with the obtained reading scores in the 6th, 7th, and 9th grades, also grouped into norm centile intervals. This provided a projection of the expected reading level to the 7th and 9th grades so that change in performance relative to expected level could be assessed.[10]

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[10]In addition, this data provided a distribution of expected reading scores for the 83 and 230 underachievers who did not have the 7th and 9th grade scores. The number of missing scores on both the 7th SAT and the 9th SAT was greatest in the lower expected reading levels (and obtained reading levels, since these were lower than the expected levels). Of the underachievers with expected reading scores below the 30th percentile, 22.6% were missing 7th grade scores compared to 11.4% with expected reading scores above the 30th percentile. In the 9th grade, 59.0% of the underachievers with expected reading scores below the 30th percentile had missing data compared to 33.7% with expected reading scores above the 30th percentile. This attrition from the lower end of the performance distribution would tend to raise the mean score of the remaining underachievers.

By this method of estimation, it was found that 91 underachievers had improved to the centile of their projected level of expected reading or higher on the 7th SAT Reading test. Although this was 20% of the 453 underachievers with 7th grade data, the figure was only 2.5% of the original 3651 subjects and was well below the percentage of possible misclassification due to errors of measurement (4.3%). Including underachievers who moved one centile closer to that of their expected level, the number who improved was 122 (3.3% of the total sample), which was still below the estimated classification error.

Comparison of the 9th SAT Reading scores with the expected level projected from the 6th grade produced similar results. Of the remaining underachievers, 98 were reading at the centile of the expected level or higher (2.7% of the original sample). Including underachievers whose scores were one centile closer to expected, 138 were improved (3.8% of the original sample).[11]

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[11] Assuming that the improvement rate was the same for subjects with missing scores, the number of subjects estimated to improve in the 7th grade would be 3.8% of the total sample. Making the same assumption for the 9th grade, the number that improved would be 6.6% of the total sample. By the 9th grade, however, a part of the missing data was accounted for by underachievers who had dropped out of school and who would not be expected to have improved. In the 7th grade, very few actual dropouts had occurred. It was found, however, that among the students who would later drop out, 13% did not have 7th grade reading scores. In comparison, only 6% of the graduates were missing 7th grade scores. This supported other findings (Lloyd, 1968) that missing information in records can be an indication of potential dropout. For graduates, the percentage of missing data was the same in all achievement groups. For dropouts there was a relationship between achievement and missing scores; 19% of underachievers did not have the 7th SAT Reading score, compared to 14% of average achievers and 9% of overachievers.

Although it cannot be said that none of the underachievers overcame the reading deficiency measured in the 6th grade, the finding that changes were within the measurement error suggested that only in a few cases did true underachievers raise their level of performance in secondary school grades.

Relationship of Achievement in Reading to Other 6th Grade Measures

Because reading is a basic skill, deficiency in reading would be expected to have an effect on the acquisition of other skills. By comparing the underachievers with the average and overachievers in reading in other areas of performance, two questions were posed. First, to what extent is underachievement in reading related to the acquisition of other skills, and second, what areas are relatively independent of reading skills. In areas that are less dependent on reading skills, it would be expected that underachievers in reading would perform as well as average achievers of comparable mental ability.

The three achievement groups were compared on the marks received in the seven courses given in the 6th grade and on the Total Arithmetic and Total Language scores of the California Achievement Test Battery (CAT Arithmetic and CAT Language scores). The 6th grade course marks in reading, literature, language,

spelling, arithmetic, social studies, and science were coded on a 3-point scale representing unsatisfactory, satisfactory, and outstanding performance as judged by the course teacher. The CAT Arithmetic and Language scores were in the form of grade equivalents. These scores were obtained at the same testing as the CAT Reading Score.

Table 6 presents the mean scores of the under-, average, and overachievers in reading on the three subtests of the CAT. The mean difference across achievement groups was significant ($p < .001$) on both the CAT Language and CAT Arithmetic scores, with underachievers in reading having the lowest mean performance.

In terms of the expected grade placement and the percentage of variance among groups accounted for, the performance of underachievers showed the least deficiency on the CAT Arithmetic subtest. On the CAT Reading subtest, the mean score for underachievers was 1.5 grade levels below grade placement, and this variable accounted for 22.2% of the variance across the achievement groups. In comparison, the mean score on the CAT Arithmetic subtest was only .4 grades below the norm, and the arithmetic subtest accounted for 4.5% of the variance across achievement groups. Performance of the underachievers on the CAT Language subtest was intermediate to that on the reading and arithmetic subtests. The mean score of underachievers was .6 grades below the norm, and this variable accounted for 6.6% of the variance across achievement groups.

Table 6

Mean Performance on Subtests of the 6th Grade CAT-Battery
of Under-, Average, and Overachievers in Reading

Test Score	Underachievers		Average Achievers		Overachievers		Total Sample	
	N	M	N	M	N	M	N	M
Total Reading	536	4.6	2537	5.8	578	7.1	3651	5.8
Total Arithmetic	530	5.7	2510	6.0	573	6.4	3613	6.0
Total Language	528	5.5	2495	6.1	571	6.5	3594	6.1

Comparison of the achievement groups on marks received in the seven 6th grade courses revealed that as a group, underachievers received significantly more marks of unsatisfactory and significantly fewer marks of outstanding than average and overachievers in all courses. The percentages of subjects in the achievement groups receiving each of the three possible marks are given in Table 7.

The percentages for the total sample showed considerable variability in the distribution of marks in the different courses.[12] In order to assess the relative performance of underachievers in different courses, this variation was controlled by computing ratios of the percentage in the achievement groups to the percentage of the total sample receiving a particular mark. The ratios for marks of unsatisfactory and outstanding are presented in Table 8. A ratio of 1.0 indicated no difference from the percentage found in the total sample. The average achievement group had ratios very close to 1.0 in all courses. Ratios greater than 1.0 indicated

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[12] This variability did not arise from differences in marking practices of individual teachers because the data from many schools were combined. It would be expected that the percentage of subjects receiving a particular mark in different courses would be the same in a sample of over 3000 subjects. Realistically, however, as possibly any of the 6th grade students could tell us, it is easier to get a good mark in spelling than in science. These general differences in marking standards most likely reflected general emphases in the curriculum or use of a more general normative basis for assigning marks. For example, if the subject matter of a particular course in the 6th grade included the introduction of new concepts rather than a continuation of material covered in previous grades, teachers might have given fewer outstanding marks on the basis that students could not master these concepts until a later grade. Conversely, fewer unsatisfactory grades may have been assigned to avoid discouraging students.

Table 7

Performance in 6th Grade Courses of Under-, Average, and Overachievers in Reading

Course	Underachievers N	Underachievers %	Average Achievers N	Average Achievers %	Overachievers N	Overachievers %	Total Sample N	Total Sample %
			Receiving Mark of "Unsatisfactory"					
Reading	174	34.5	366	15.5	39	7.3	579	17.0
Literature	118	24.5	265	11.6	25	4.8	408	12.4
Language	123	24.4	251	10.6	27	5.1	401	11.8
Spelling	143	28.4	322	13.6	39	7.3	504	14.8
Arithmetic	121	24.0	354	14.9	45	8.4	520	15.3
Social Studies	94	18.6	221	9.3	24	4.5	339	9.9
Science	74	14.7	177	7.6	22	4.1	273	8.1
			Receiving Mark of "Satisfactory"					
Reading	270	53.6	1345	56.8	231	43.1	1846	54.2
Literature	323	67.0	1534	67.0	295	57.1	2152	65.4
Language	337	66.9	1644	69.4	318	59.6	2299	67.5
Spelling	297	59.0	1397	58.9	266	49.5	1960	57.5
Arithmetic	312	61.9	1473	62.1	300	56.3	2085	61.2
Social Studies	357	70.8	1642	69.2	314	58.5	2313	67.8
Science	392	78.1	1820	77.8	366	68.5	2578	76.4
			Receiving Mark of "Outstanding"					
Reading	60	11.9	657	27.7	266	49.6	983	28.8
Literature	41	8.5	492	21.5	197	38.1	730	22.2
Language	44	8.7	473	20.0	189	35.4	706	20.7
Spelling	63	12.5	652	27.5	232	43.2	947	27.8
Arithmetic	71	14.1	544	22.9	188	35.3	803	23.6
Social Studies	53	10.5	508	21.4	199	37.1	760	22.3
Science	36	7.2	343	14.7	146	27.3	525	15.6

Note.--Chi squares across achievement groups significant for each course ($p < .001$).

Table 8

Ratios of Percentage in Achievement Group to Percentage in Total Sample Receiving Marks of Unsatisfactory and Outstanding in 6th Grade Courses

Course	Unsatisfactory			Outstanding		
	Under-achievers	Average achievers	Over-achievers	Under-achievers	Average achievers	Over-achievers
Reading	2.03	.91	.43	.41	.96	1.72
Literature	1.98	.94	.39	.38	.97	1.72
Language	2.07	.90	.43	.42	.97	1.71
Spelling	1.92	.92	.49	.45	.99	1.55
Arithmetic	1.57	.97	.55	.60	.97	1.50
Social Studies	1.88	.94	.45	.47	.96	1.66
Science	1.81	.94	.51	.46	.94	1.75

a higher percentage than the total sample, and the underachievement group typified this over-representation in unsatisfactory marks. A ratio less than one indicated a lower percentage than in the total sample, and the underachievers consistently show this pattern for outstanding marks. Relative to the total sample, underachievers in reading did best (were least deficient) in the courses of arithmetic and science and poorest in the courses of reading, literature, and language. Overachievers in reading showed the reverse pattern, doing better in those courses that are logically most related to reading skills and least well in the arithmetic and science courses.

It was also noted that 11.9% of the underachievers in reading received a mark of outstanding in the reading course. In part, this supports findings from other studies (Chansky, 1964; Board of Education of Prince George's County, Maryland, 1957) that many factors other than mastery of the subject area itself enter into the marks assigned by teachers. It also must be considered in interpreting this finding that the standard for marking in public schools is most often the normative expectation for grade level rather than a level to be expected from an individual student's potential. With the definition of underachievement in this study, 9.5% of the underachievers had achievement test reading scores above the 50th percentile. Many of these students were probably included in the 12% receiving marks of outstanding in the reading course.

Relationship of Reading Achievement to Academic Performance in Secondary School

The academic performance in secondary school grades of the three achievement groups was measured by grade point averages, scores on standardized tests in grades 7 and 9, and the number of retentions (nonpromotions) from grades 7 to 12.

Two types of grade point averages were calculated. The first was the average in each grade (7 to 12) of the final marks in courses receiving a full unit credit (mathematics, English, science, social studies, and foreign languages). For subjects withdrawing during the second semester of a year, the available marks for that year were averaged. Where a complete grade or certain courses were repeated because of failures, only the repeated course marks were included in the average. If a subject failed the same course twice and did not repeat it, the last failure, or mark of E, was counted in the average. In effect, this method of calculating the average made these variables measures of the best performance of a student in the more academic subjects at each grade level. The second type of grade point average was the course-area grade point average. This average consisted of the final marks for courses within a subject area averaged over the years that a student was in school (from grades 7 to graduation or withdrawal). A grade point average was calculated for 10 course areas: English, social studies, science, mathematics, business, vocational, foreign

languages, art, physical education, and music. Courses in speech, dramatics, and journalism were included in the English area; history, geography, and psychology in the social studies area, etc. In contrast to the yearly grade point averages, where there was a reduced sample of subjects at each grade level, the course area grade point averages were available for all subjects except those who transferred or dropped out in the 7th grade. The number of courses on which the average was based, however, differed among subjects. For the required courses, averages were available for approximately 3300 subjects; lower numbers of subjects had averages in elective courses. In calculating both types of grade point averages, course marks were assigned codes ranging from 5, for a mark of A, to 1, for a mark of E.

In Table 9, the mean grade point averages for the three achievement groups from grades 6 to 12 are shown. Tests of mean differences were significant at each grade level, with underachievers having the lowest level of performance. As with 6th grade course marks, there was a variation in the mean grade point average of the total sample over grades 7 through 12. The pattern in the total sample was a decrease in mean grade point average from grades 7 to 10 and an increase in grades 11 and 12. The lowest mean performance

Table 9

Grade Point Averages in Grades 6 to 12 of
Under-, Average, and Overachievers in Reading

Grade[a]	Underachievers		Average Achievers		Overachievers		Total Sample	
	N	M	N	M	N	M	N	M
6	504	1.74	2371	1.97	537	2.19	3412	1.97
7	491	2.84	2310	3.25	509	3.62	3310	3.25
8	462	2.79	2174	3.15	480	3.53	3116	3.16
9	421	2.82	2061	3.08	448	3.35	2930	3.09
10	391	2.62	1895	2.84	419	3.12	2705	2.85
11	326	2.74	1607	2.93	360	3.14	2293	2.94
12	286	2.98	1444	3.18	332	3.36	2062	3.18

Note.--F tests across achievement groups significant at each grade ($p < .001$).

[a]In grade 6, the average was of three possible marks: 1 - unsatisfactory, 2 - satisfactory, 3 - outstanding. In grades 7 to 12, letter marks from A to E were assigned. In the coding, 1=E and 5=A.

was in grade 10.[13] Since the mean grade point average for the average achievers differed only slightly from that of the total sample, the mean of this group was used as the standard to compare the relative performance of the achievement groups. The pattern of performance over secondary school grades can be seen in Figure 3.

The profiles of the three achievement groups showed two things of note. First, at each successive grade, the difference in mean level of performance of the three groups decreased.[14] The longitudinal design of the study, with dropouts at each grade level, may have contributed to this finding of an increasingly more homogeneous performance among the remaining students. Second, there was no marked change in the level of performance of underachievers relative to the other groups. As a group, the underachievers in reading in the 6th grade were consistently rated lower in their performance in academic subjects than their peers through all six years of secondary school.

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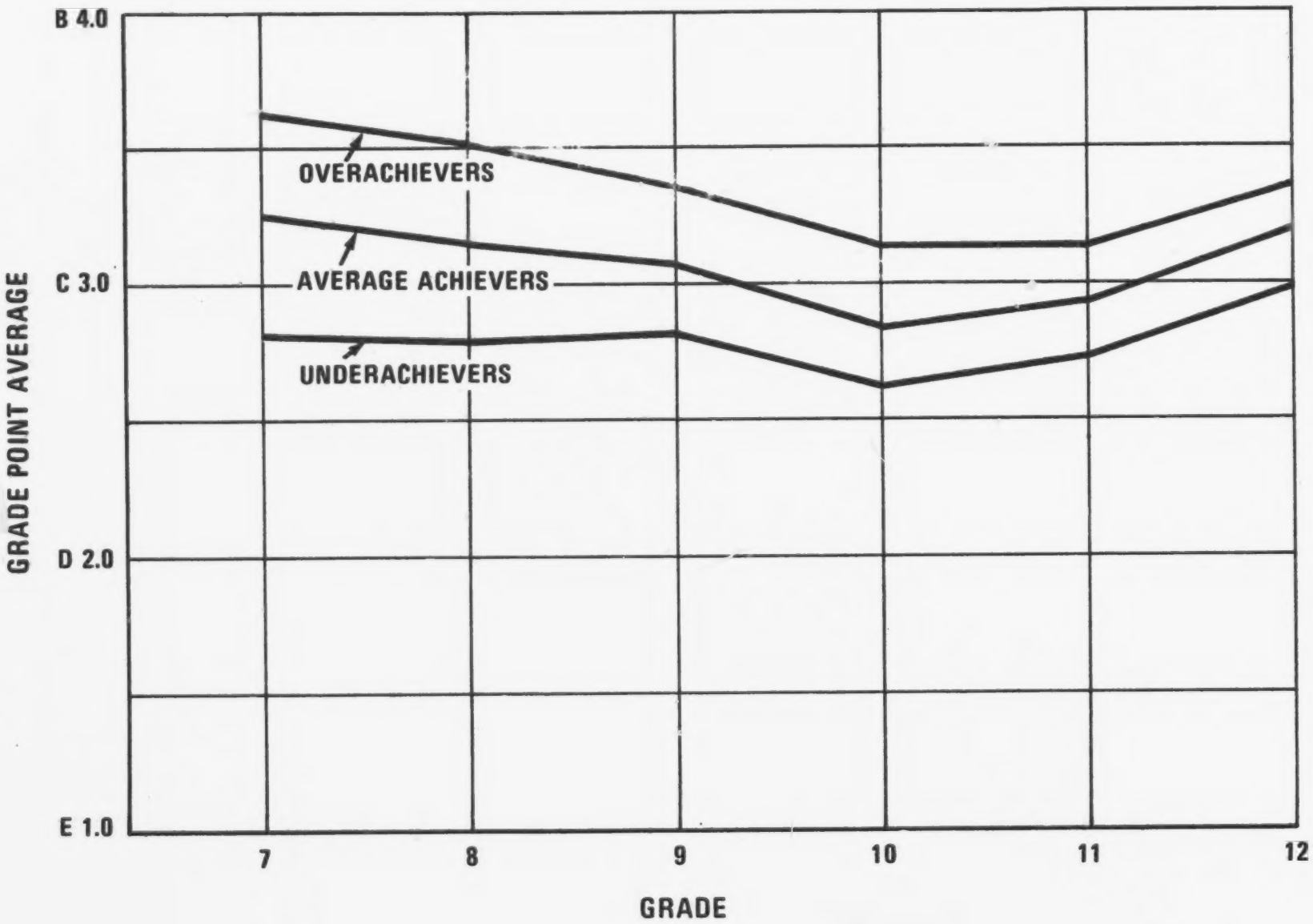
[13] This school system had a 6-3-3 progression, with grade 10 being the first year of high school. The general assignment of lower marks by teacher in this grade could have reflected a more stringent criterion of performance applied at the high school level. It is also possible that the lower performance reflected difficulty in adjustment for some students on entering high school; however, this hypothesis would assume that teachers apply a uniform criterion in assigning marks, which is not supported by other evidence in this report.

[14] The omega^2 statistic also reflected this increased similarity in level performance over successive grades. The percentage of variance accounted for by grade point averages in successive grades was: 5.9% in the 6th grade, 4.4% in the 7th, 3.7% in the 8th, 2.2% in the 9th, 2.0% in the 10th, 1.4% in the 11th, and 1.6% in the 12th.

FIGURE 3

GRADE POINT AVERAGES IN SECONDARY SCHOOL FOR UNDER-, AVERAGE, AND OVERACHIEVERS IN READING



In order to determine whether underachievers in reading performed better in some course areas than in others, the course area grade point averages for the three achievement groups were compared. Table 10A presents the mean grade point averages in the 10 course areas for the three achievement groups. Comparison of these means revealed a significant difference across the three groups in every course area, with the underachievers having the lowest performance of the three groups. As was found with the 6th grade marks and the other grade point averages, there was variation in the mean performance of the total sample across the course areas. Although the mean difference tests indicated that the underachievement group performed lower in all areas, it was necessary to control this variation in order to assess the relative performance of underachievers in different subject matter areas. Since the mean performance of the average achievement group was very close to that of the total sample in all course areas, the mean of this group was used as the standard of expected performance in the different areas. In Figure 4, the profile of mean performance for the three groups over the 10 course areas is presented to facilitate comparison. There were only minor differences in the patterns of performance of the three groups and no indication that underachievers in reading as a group did better in any subject area.

The omega^2 statistic was also used to evaluate the relative performance of the underachievers in different course areas. These figures are presented in Table 10B, expressed as percentages. In

Table 10A

Grade Point Averages in Secondary School Course Areas
for Under-, Average, and Overachievers

Course Area	Underachievers		Average Achievers		Overachievers		Total Sample	
	N	M	N	M	N	M	N	M
English	490	2.68	2309	3.01	508	3.34	3307	3.01
Social Studies	490	2.72	2310	3.04	508	3.41	3308	3.05
Science	428	2.60	2060	2.87	447	3.14	2935	2.86
Mathematics	490	2.64	2309	2.93	508	3.21	3307	2.93
Business	253	2.67	1265	2.83	263	3.04	1781	2.84
Vocational	487	3.19	2296	3.40	505	3.62	3288	3.40
Foreign Languages	144	2.38	904	2.83	244	3.16	1292	2.84
Music	485	3.39	2278	3.66	500	3.84	3263	3.65
Art	464	3.25	2153	3.41	469	3.55	3086	3.41
Physical Education	486	3.62	2292	3.73	502	3.88	3280	3.74

Table 10B

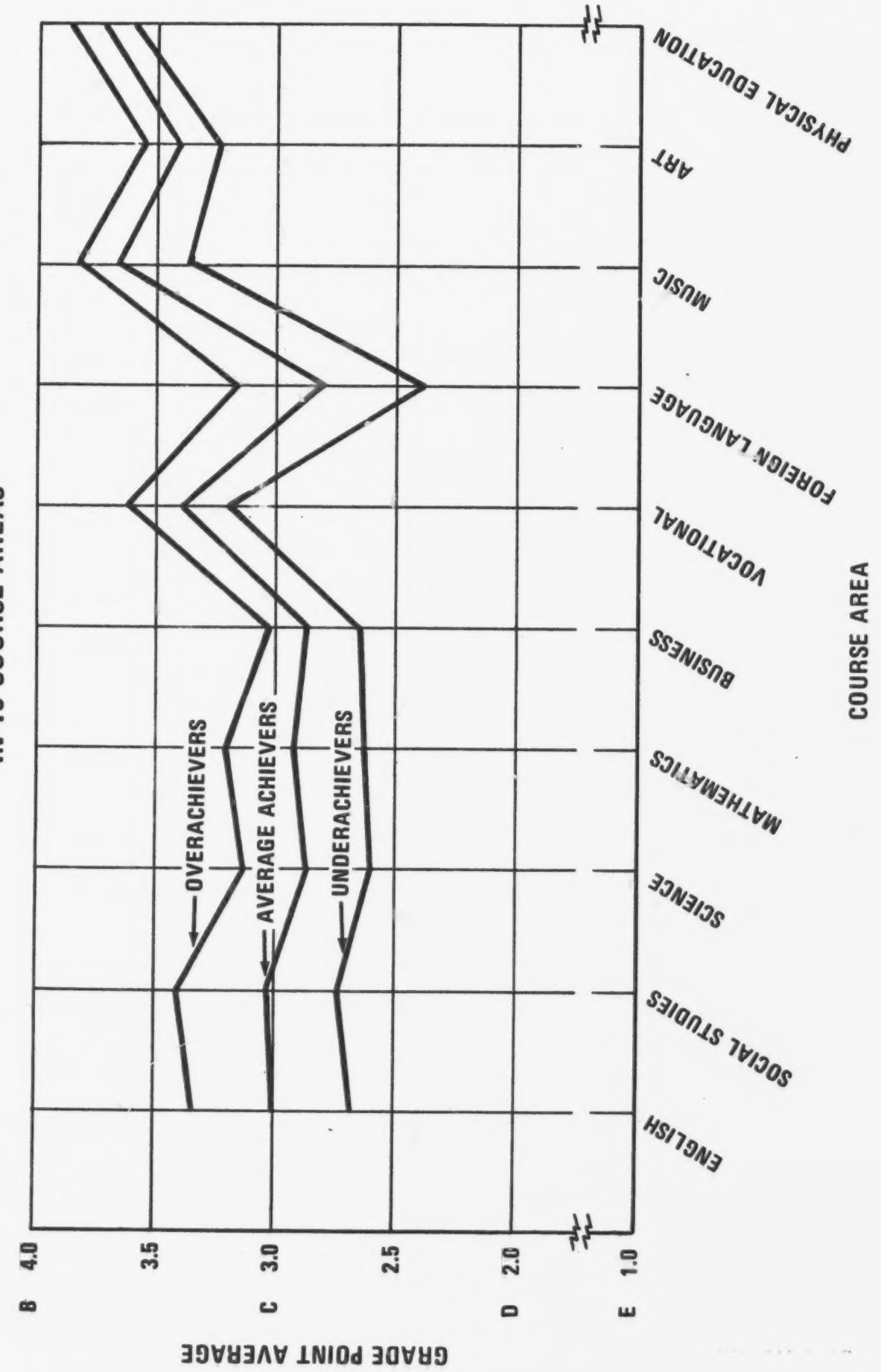
Grade Point Averages in Secondary School Course Areas for Under-, Average, and Overachievers

Course Area	F[a]	Omega^2
English	65.76	3.77
Social Studies	68.04	3.90
Science	35.73	2.31
Mathematics	43.98	2.53
Business	7.92	.77
Vocational	32.03	1.85
Foreign Language	18.45	2.63
Music	28.95	1.68
Art	13.39	.80
Physical Education	12.90	.72

[a]All F's significant, $p < .001$.

FIGURE 4

PROFILE OF MEAN PERFORMANCE OF UNDER-, AVERAGE, AND OVERACHIEVERS IN 10 COURSE AREAS



evaluating the performance of underachievers in different course areas, it was necessary to take into consideration that students were required to take courses in some areas, while other areas were elective. The business and vocational course areas were also selective for some students because they corresponded to two of the four curricula.[15] One of the factors in the selection of these curricula could have been poor reading skills. It would be expected that the performance of underachievers would be better in curricula that were less dependent on reading skills because they would be less handicapped by reading skills and could capitalize on other interests and skills requisite to success in the selected area.

In the areas where courses were required of all students, underachievers were closer to the performance of average achievers in science and mathematics than in English and social studies. Except in the area of foreign languages (required in the Academic curriculum), there was less difference among the achievement groups in other areas. The best performance of underachievers was in the business area.

Comparisons of the achievement groups on the reading tests administered in grades 7 and 9 were reported in a previous section. Also available for comparison were scores on the SAT Language and

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[15]Four units in English, three units in social studies, and two units in science were required for graduation in all curricula. One or two mathematics courses were required, depending on the specific curriculum. The four curricula for grades 9 through 12 were Academic, General, Business, and Vocational.

Arithmetic scores given in 7th grade and scores on the Iowa Test of Educational Development (ITED) given in the second semester of the 9th grade.

The performance of the achievement groups on the SAT in the 7th grade paralleled that on the CAT in the 6th grade. Mean differences were significant on all three subtests ($p < .001$); underachievers performed below average achievers and below norm grade placement on all subtests; underachievers showed the least deficit on the arithmetic subtest and the most deficit on the reading subtest.

Standard scores were coded for the following ITED subtests: Social Concepts Background, Natural Science Background, English Expression, Quantitative Thinking, Social Studies Reading, Natural Science Reading, Literature, General Vocabulary, and Use of Sources of Information. Results of the comparison of the achievement groups on these subtests are given in Tables 11A and 11B. In Table 11A, the means of the achievement groups and the norm percentile ranks for each mean are given to allow comparison both among groups and to the norm standardization sample.

Although on some subtests the underachievers were performing near the 50th percentile, their mean performance was significantly lower than that of average and overachievers on all subtests ($p < .001$). The percentage of variance among the achievement groups accounted for by subtests (Table 11B) indicated that underachievers were least different from average achievers on the subtests of Quantitative Thinking and Natural Science Concepts. Differences among the groups

Table 11A

Mean Performance and Norm Percentile Rank on 9th Grade Iowa Test of Educational Development of Under-, Average, and Overachievers in Reading

Subtest	Underachievers (N=375)		Average Achievers (N=1820)		Overachievers (N=390)		Total Sample	
	M	Percentile Rank	M	Percentile Rank	M	Percentile Rank	M	Percentile Rank
Social Concepts	10.3	35	12.1	51	13.9	64	12.1	51
Natural Science	11.2	45	13.1	58	14.8	69	13.1	58
English Expression	11.6	47	13.2	60	14.9	71	13.2	60
Quantitative Thinking	11.8	49	13.0	68	14.4	76	13.0	68
Social Studies Reading	11.1	48	13.1	62	15.2	77	13.1	62
Natural Science Reading	10.1	45	11.9	57	14.0	70	12.0	58
Literature	9.3	41	11.6	56	13.5	68	11.5	55
Vocabulary	11.0	51	13.1	60	15.3	72	13.1	60
Use of Information	11.2	51	13.1	64	15.1	76	13.1	64

Note.--Means are expressed in standard scores. The number of subjects varies slightly on different subtests (see Appendix for specific N's). Percentile of ranks were for the second semester of the 9th grade (Lindquist, E.F. The ITED General Manual. Chicago: Science Research Associates, 1959).

Table 11B

Mean Performance and Norm Percentile Rank on 9th Grade Iowa Test of Educational Development of Under-, Average, and Overachievers in Reading

Subtest	F[a]	Omega^2
Social Concepts	42.57	3.11
Natural Science	34.07	2.50
English Expression	39.87	2.90
Quantitative	16.69	1.19
Social Studies Reading	54.34	3.96
Natural Science Reading	41.68	3.03
Literature	53.83	3.92
Vocabulary	57.39	4.17
Use of Information	41.71	3.08

[a]All F's significant, $p < .001$.

were greatest on the subtests most related to reading skills: Social Studies Reading, Natural Science Reading, Literature, and Vocabulary. It was also interesting that on the two subtests measuring reading in different subject matter area, underachievers did relatively better on Natural Science Reading than on Social Studies Reading (compared to other achievement groups, not to the norm percentile).[16]

Nonpromotion in secondary school is a gross measure of academic achievement in that it represents failure in a sufficient number of courses that a student is required to repeat a grade. In the total sample, 82.7% of the students had no retentions in secondary school; 13.1% were retained once; and 4.3% had two or more retentions. There was a significantly larger percentage of retentions among underachievers in reading when compared to average achievers or the total sample ($p < .001$). Sixteen percent of the underachievers were retained once and 7% were retained twice in secondary school grades (Table 12). As with other performance measures, there was a trend across the three achievement groups with overachievers in reading having fewer retentions than average achievers.

Relationship of Reading Achievement to Later Behavior and Adjustment

The measures that could be used to determine the relationship of achievement in reading to adjustment and behavior in secondary

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[16]The higher scores for some underachievers on the Natural Science Reading subtest may not have resulted from better reading skills in this area. Since underachievers showed less deficit in their performance on Natural Science Concepts and other measures of performance in science (the science grade point average), it is possible that better knowledge of these concepts compensated for their lower reading skills, resulting in higher scores on this test.

Table 12

Number of Retentions (Nonpromotions) in Secondary School Grades of Under-, Average, and Overachievers in Reading

Retentions	Underachievers		Average Achievers		Overachievers		Total Sample	
	N	%	N	%	N	%	N	%
None	387	76.6	1970	82.7	466	88.3	2823	82.7
One	82	16.2	315	13.2	49	9.3	446	13.1
Two or more	36	7.1	97	4.1	13	2.5	146	4.3

school were the number of days absent in each secondary school grade, the number of school activities in which students participated in grades 7 to 10, and the Cornell Index, which was administered to the 11th grade classes.

The three achievement groups differed very little in the mean number of days absent, and differences were not statistically significant in any secondary school grade. The mean number of days absent ranged from 8 to 15 days in all groups and in all grades.[17]

The number of school activities listed on the secondary school records for grades 7 through 10 were examined to assess the participation in the social aspects of secondary school of the three achievement groups. Although it was not possible when there was no indication on a school record to determine whether there was no participation or whether activities were not listed by the teacher, the record was set up in such a way as to facilitate the recording of school activities of students. A list of activities and organizations appeared on the school record with columns

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[17]Although absence in secondary school could be the result of several things, a general tendency to greater absence among underachievers would be an indication of a loss of interest in the educational process. For example, from other analyses of data with this study population, it was found that a pattern of increased absence over the years prior to withdrawal was characteristic of high school dropouts (Lloyd, 1968). On the other hand, a positive reaction to lower achievement would be perseverance accompanied by increased attendance. Also, since overachievers in reading had above average performance in course work, they might not have considered absence as detrimental to their educational goals and would not consider constant attendance as necessary. A counterbalancing of these behaviors would obscure differences between the groups.

for each year to be checked by the teacher. There was also space on the record for additional activities to be listed.

Examination of the tabular data indicated that for students who participated in activities there were no differences among the achievement groups in the number of activities.[18] There were differences, however, between underachievers, average achievers, and overachievers in the percentage of students who had no participation in school activities indicated on their secondary school records. These percentages are presented in Table 13. The trend of differences was consistent from grades 7 to 10, with underachievers in reading having a higher percentage of no participation in each grade. Only the difference in the 7th grade, however, was statistically significant ($p < .05$). Although a few more underachievers in reading may have been isolates or nonparticipants in secondary school activities, this was not found to be strongly characteristic of this group.

The Cornell Index is a questionnaire dealing with psychiatric symptomotology and was designed as a screening device to differentiate persons with personal and emotional disturbances from the rest of the population. With the absence of standardized norms for a high school population on this test, scores were coded into six intervals that approximated percentile levels for college

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[18] Activities ranged from participation in sports to student government, drama, history, and science clubs. Differences might be found if the type of school activity were taken into consideration.

freshmen reported in the test manual (Weider, A., Wolffe, H. G., et al., 1949).

The mean difference between achievement groups on the Cornell Index was not significant. The means for underachievers, average achievers, and overachievers were 3.1, 3.0, and 3.0, respectively. The code of 3 was assigned for 8 to 12 questions answered in the problem direction and corresponded to the percentile range for college freshmen of 20-40 (that is, more problems were indicated than in the freshman sample).

Relationship of Reading Achievement to Outcome

Table 14 presents the percentage of secondary school transfers, graduates, and dropouts who were underachieving in reading 1 S.E.E. and 1½ S.E.E. below their expected reading score. Among dropouts, there was a higher prevalence of reading deficiency at both of these levels. Approximately 18% of the dropouts were underachievers in reading in the 6th grade compared to 14% of the graduates. The percentage of transfers who were underachievers was slightly higher than that among graduates, which would be expected if this group contained subjects who eventually graduated and dropped out in the same proportions as the known cases. In Table 15, the transfers have been excluded from the calculations, and the percentage of dropout or graduation for underachievers, average achievers, and overachievers is presented. Referring to the bottom of the table, it can be seen that of the 2843 subjects who were known to either drop out or graduate, 26.9% were dropouts and 73.1% were graduates.

Table 14

Percentage of Reading Deficiency in Outcome Groups

Group	Underachievers Below 1 S.E.E. N	%	Below 1½ S.E.E. N	%
Transfers (N=808)	113	14.0	41	5.1
Graduates (N=2078)	287	13.8	94	4.5
Dropouts (N=765)	136	17.8	48	6.3
Total Sample (N=3651)	536	14.7	183	5.0

Table 15

Percentage of Dropouts & Graduates in Different Reading Achievement Groups

Group	Dropouts N	%	Graduates N	%
Underachievers (N=423)	136	32.2	287	67.8
Average Achievers (N=2000)	544	27.2	1456	72.8
Overachievers (N=420)	85	20.2	335	79.8
Total Sample (N=2843)	765	26.9	2078	73.1

Among underachievers, 32.2% became dropouts, compared to 27.2% of the average achievers and 20.2% of overachievers. The difference across achievement groups was significant ($p < .01$).

Follow-up information from counselor records in the year following graduation (September - March 1962) was available for 1129 high school graduates. This data was coded to indicate the type of school attended the following year or the type of employment obtained after graduation.

Comparison of the three achievement groups on the number of graduates continuing their training after high school or entering the world of work is presented in Table 16. Where 69% of the graduates on whom information was available were attending a school, college, or university in the year following graduation, only 57% of the underachievers were found to be continuing training. The difference across the achievement groups was significant ($p < .001$). The highest percentage of graduates continuing training beyond high school was found among overachievers (79%). The 3% of the sample in the "Neither" category largely consisted of girls who married after graduation and at the time of follow-up were not working nor attending a school or college.

A comparison of the type of school entered by the 783 graduates who continued their education after high school is presented in Table 17. Although underachievers in reading attended business or technical schools more than average and overachievers, the differences were not statistically significant.

Table 16

Follow-up Information for Graduates with Under-, Average, and Overachievement in Reading

	Underachievers		Average Achievers		Overachievers		Total Graduates	
	N	%	N	%	N	%	N	%
School, college or university	78	56.9	550	69.1	155	79.1	783	69.4
Working	53	38.7	222	27.9	37	18.9	312	27.6
Neither	6	4.4	24	3.0	4	2.0	34	3.0
Total	137	100.0	796	100.0	196	100.0	1129	100.0

Note.--Chi square for school or work (excluding Neither category) = 17.24, $p < .001$.

Table 17

Type of School Entered by Graduates with Under-, Average, and Overachievement in Reading

	Underachievers		Average Achievers		Overachievers		Total Graduates Entering School	
	N	%	N	%	N	%	N	%
Technical or business school	12	15.4	50	9.1	15	9.7	77	9.8
College	29	37.2	194	35.3	53	34.2	276	35.2
University	37	47.4	306	55.6	87	56.1	430	54.9
Total	78	100.0	550	100.0	155	100.0	783	100.0

Note.--Chi square = 3.72, 4 df, not significant.

Table 18

Type of Employment of Graduates with Under-, Average, and Overachievement in Reading

	Underachievers		Average Achievers		Overachievers		Total Graduates Working	
	N	%	N	%	N	%	N	%
Unskilled or semi-skilled	13	24.5	59	26.5	14	37.8	86	27.6
Skilled	8	15.1	29	13.1	3	8.1	40	12.8
Clerical, semi-professional or administrative	32	60.4	134	60.4	20	54.1	186	59.6
Total	53	100.0	222	100.0	37	100.0	312	100.0

Note.--Chi square = 2.73, 4 df, not significant.

In Table 18, the type of work obtained by the 312 graduates who entered the world of work after graduation is presented. There was not a significant difference among the three achievement groups in the type of work obtained by these graduates. The highest percentage of subjects in all achievement groups entered clerical occupations.

Thus, in educational attainment of the achievement groups, there was a greater attrition for underachievers at the two levels observed. Of the initial 423 dropouts and graduates who were classified as underachievers in the 6th grade, only 68% graduated from high school, compared to 73% of the total number of dropouts and graduates. Doubling the number of underachievers known to continue training after graduation to account for the fact that follow-up information was obtained on only half of the graduates, it would be estimated that 156, or 37% of the original 423, continued training beyond high school. Employing the same method of estimation, 55% of the total number of dropouts and graduates in the original cohort continued training beyond high school.

Discussion

This study was directed at (1) determining the prevalence of reading deficiency in a study population, and (2) relating levels of reading achievement in the 6th grade to later educational performance and attainment. The second of these purposes was an attempt to measure the extent to which underachievement in reading

would predict later performance in various areas. For the study, it was accepted that general ability is related to school success, and underachievement was defined in such a way that relationships independent of level of mental ability could be investigated. The consistency of the findings on different types of measures at different grade levels showed that reading skills measured in elementary school had a wide range of relationships to later academic performance. Comparison of achievement groups in different subject areas revealed overachievers to be students with high verbal skills, with superior performance in areas of literature, reading, language skills, foreign languages, and social studies and a lower level of performance in the areas of science and mathematics. The reverse pattern was found for underachievers, who had a low level of performance in areas related to reading skills and a relatively higher level of performance in the areas of science and mathematics. In general terms, the results suggested that underachievers were individuals with relatively high numerical ability and overachievers were individuals with relatively high verbal ability. If this was the case, then why was it that the students with high verbal ability were superior to students with high numerical ability in all areas measured. In spite of the fact that the groups were equated on IQ scores in the 6th grade, were the underachievers really equal to the average and overachievers in mental ability? Although part of the findings may be explained by the emphasis on verbal ability in the educational criteria, some of the measurement problems in

the study should also be considered for their possible effect on the results.

First, difference scores, such as the discrepancy score by which reading achievement was classified, can be expected to have disappointingly low reliabilities because they incorporate errors of measurement from both tests from which they are derived. In our classification of underachievers, it was estimated that there was a possible 4.3% error that could result from errors of measurement in the CTMM and CAT Reading tests. Results of the testing on the Lorge-Thorndike Intelligence Tests in the 7th grade supported that there was some misclassification of subjects due to the reliability of the 6th grade tests. Underachievers whose mean IQ score was slightly higher than that of average or overachievers in the 6th grade (103.1) was lower on retest a year later (95.4). In contrast, overachievers had a mean IQ score of 101.9 in the 6th grade and a mean score of 107.6 when retested in the 7th grade. Average achievers showed a slight mean change from 102.3 in the 6th grade to 101.3 in the 7th grade. The difference in IQ score in the 7th grade across achievement groups was significant ($p < .001$).[19]

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[19]The 7th grade test was the 1954 edition of the Lorge-Thorndike Intelligence Test. This test was also administered in the 10th grade. Comparison of mean IQ of the achievement groups in grades 7 and 10 showed an increase for all groups. This was consistent with expectation that the attrition of students from grades 7 to 10 would be primarily students of lower mental ability, therefore raising the mean level of performance for remaining students. Means, standard deviations, and analysis of variance data for the 7th and 10th grade tests are given in the Appendix.

The difference among achievement groups on the 7th grade IQ score raises the question as to whether underachievers were actually equal to the average and overachievers in mental ability. This, in turn, makes it uncertain as to whether differences in later performance were attributable to differences in reading skills or in general mental ability. Although the uncertainty remains for smaller differences, additional factors supported that many findings resulted primarily from differences in the reading achievement classification rather than IQ differences. First, the percentage of variance accounted for by later intelligence test scores was not sufficient to account for all differences found among groups on later measures of reading and other verbal skills (assuming that all differences in IQ would be related to performance on these measures). In the numerical ability areas, arithmetic, science, etc., differences between achievement groups were not as great, and there was greater possibility that differences in general ability contributed to the significance of differences. Second, if the reliability of the tests resulted in subjects being classified as underachievers whose true (i.e., completely reliable) IQ or reading scores would have designated them as average achievers, then there were also, from errors of measurement, subjects in the average achievement group whose true scores would indicate underachievement. Since significant differences were found with misclassification on both sides, analyses with more reliable scores would be expected to increase some differences.

The possibility of actual decrease in the measured IQ of underachievers should not be discounted. There are two characteristics of group intelligence tests that together could contribute to such a decrease over time. The first of these characteristics is the heavy weighting of verbal ability in group IQ tests. The largest component of these tests measures verbal ability, and performance on nonverbal parts of group tests can also be affected by ability to read instructions. With the close relationship of the concepts of reading achievement and verbal ability, there is the problem of differentiating performance on later measures of the variable being controlled (the IQ score) from performance on the experimental variable (the reading achievement score). The second characteristic of group IQ tests that could affect the performance of underachievers concerns the concept of mental ability and, in particular, how it is measured. Although mental ability is used to refer to a capacity or general summation of abilities that is independent of specific learning and achievement, in reality it is impossible to estimate mental ability separately from the learning process. Norms for intelligence test performance are based on the performance of different age groups, and the subject matter in intelligence tests becomes progressively more difficult in forms used at higher age levels to account for the increase in skills and achievement of children as they become older. The student with deficiency in reading skills must advance at the same rate as the normal reader if he is not to be successively more handicapped by

advanced forms of tests of verbal ability. If underachievers who were deficient at one level find the progressively increasing complexity of subsequent achievement measures an increasing handicap, as indicated for slow learners (Tilton, 1949, 1951) and for underachievers in the study of Shaw and McCuen (1960),[20] then performance on the verbal ability components of intelligence tests may also decrease over successive testings.

Since a slightly higher percentage of underachievers than average or overachievers were retained in the 6th grade (as well as in secondary school grades), the artifact of age in the IQ score could also have contributed to a lower mean IQ score in the underachievement group on subsequent testings. The relationship of age and learning in the educational system is not the same as that of age and IQ scores. Educational progression is more of a step function, where learning to one level is required before progression to the next level. The retained student leaves his initial cohort and in succeeding years is approximately 12 months older than his new peers. Even though deficiencies that lead to retention may be remedied in the repeated year in grade, only in the exceptional case would it be expected that a student would accelerate his

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20 Shaw and McCuen found an increasing disparity between the performance of average and underachievers from elementary through secondary school. This was not a finding in the present data. The two studies, however, differed in methodology. The present study followed a cohort forward in time with attrition of the group in subsequent grades; Shaw and McCuen selected groups at an end point and compared performance over prior years.

learning to reach the level of his former classmates. Because of the artifact of age in the IQ score, however, the retained student will have an IQ score 8 points lower than his younger peers of comparable mental age in subsequent years. With the factors that could affect later performance on IQ tests, the general conclusions concerning the relationship of reading achievement to later achievement appear tenable, that reading deficiency persists over secondary school grades and that underachievers have lower performance in areas related to reading skills. Further investigation is needed to clarify whether differences that were found in the achievement groups in science, mathematics, business, and vocational areas should be attributed to differences in reading achievement.

Results of this study are of value to those concerned with programs, both remedial and general, in education because they support the importance of developing adequate reading skills in elementary school. There is a considerable gap, however, between the information gained from research on a general group of students and the information needed for the understanding of the individual underachieving student. In order to gain a better understanding of the characteristics of the underachievers, other factors that affect achievement need to be considered. Previous studies have suggested that the characteristics and relationships of underachievement may differ when sex, race, socio-economic level, family characteristics, and motivation of the underachiever are taken into account (Lavin, 1965). Except for the last of these

areas, data were available on the present study population that could be related to levels of reading achievement. In subsequent parts of this report, the differential relationships of reading achievement to later performance will be investigated for students in upper and lower ranges of mental ability, students from upper and lower levels of socio-economic background, and for students of different race and sex. In addition, the relationship of educational and occupational background and family characteristics to reading achievement will be reported.

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Appendix

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LLOYD 1-14:  READING DEFICIENCY ANALYSIS OF VARIANCE RUNS

LLOYD 1-14:  READING DEFICIENCY ANALYSIS OF VARIANCE RUNS - COMBINED GROUPS

NO OF VARIABLES =  57     CLASSIFICATION VAR = # 57     WITH ELIMINATION CODE FOR CLAS. VAR =   999.000

CLAS CATEGORY UPPER LIMITS =   91.000, 108.000, 990.000,   0.0 ,   0.0 ,   0.0 ,   0.0 ,   0.0 ,   0.0 ,   0.0 ,

RESTRICTION VAR = #  0     WITH RANGE OF     0.0    TO     0.0

CODES TO BE EXCLUDED FOR VARS 1 TO  57 ARE     0.0 ,    0.0 ,    0.0 ,   -9.000,    0.0 ,    0.0 ,
    0.0 ,    0.0 ,    0.0 ,    0.0 ,    0.0 ,    0.0 ,    0.0 ,    0.0 ,    1.000,    0.0 ,    0.0 ,
    0.0 ,    0.0 ,    0.0 ,    0.0 ,    0.0 ,    0.0 ,    0.0 ,    0.0 ,    0.0 ,    0.0 ,    0.0 ,
    0.0 ,    0.0 ,    0.0 ,    0.0 ,    0.0 ,    0.0 ,    0.0 ,    0.0 ,    0.0 ,    0.0 ,    0.0 ,
    0.0 ,    0.0 ,    0.0 ,    0.0 ,    0.0 ,    0.0 ,  999.000,

FORMAT OF DATA IS (57F6.0)

MAX # OF OBS TO BE INCLUDED THIS PROBLEM =  3921  DATA TO BE READ FROM  TAPE WITHOUT REWIND

GROUP 1 = UNDERACHIEVERS

GROUP 2 = AVERAGE ACHIEVERS

GROUP 3 = OVERACHIEVERS
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LLOYD 1-14: READING DEFICIENCY ANALYSIS OF VARIANCE RUNS

LLOYD 1-14: READING DEFICIENCY ANALYSIS OF VARIANCE RUNS - COMBINED GROUPS

J		1	2	3	Variable	TOTAL
1	N	536	2537	578	Age in the 6th Grade	3651
	M	138.884	140.055	141.848		140.167
	SD	6.857	6.905	7.613		7.062
2	N	508	2421	549	Education Level of Father	3478
	M	4.089	3.838	3.464		3.815
	SD	1.674	1.754	1.845		1.765
3	N	512	2427	551	Education Level of Mother	3490
	M	3.982	3.837	3.666		3.832
	SD	1.492	1.589	1.548		1.571
4	N	536	2537	578	Number of Siblings	3651
	M	2.354	2.371	2.121		2.329
	SD	1.938	2.086	1.825		2.027
5	N	501	2383	546	Occupation Level of Father	3430
	M	4.541	4.386	4.027		4.351
	SD	1.475	1.621	1.704		1.621
6	N	508	2402	548	SES Level	3458
	M	3.537	3.401	3.130		3.378
	SD	1.077	1.171	1.246		1.176
7	N	504	2371	537	6th Grade Point Average*	3412
	M	17.381	19.724	21.899		19.720
	SD	5.073	4.936	5.049		5.127
8	N	536	2537	578	6th Grade CTMM IQ Score	3651
	M	103.104	102.248	101.922		102.322
	SD	15.508	16.854	18.883		17.003
9	N	285	1391	289	Days Absent 1st	1965
	M	2.895	2.978	3.176		2.995
	SD	1.325	1.422	1.436		1.412
10	N	316	1546	322	Days Absent 2nd	2184
	M	2.649	2.672	2.845		2.694
	SD	1.275	1.342	1.347		1.334
11	N	363	1750	365	Days Absent 3rd	2478
	M	2.807	2.748	2.855		2.772
	SD	1.183	1.269	1.317		1.264
12	N	401	1923	404	Days Absent 4th	2728
	M	2.439	2.381	2.465		2.402
	SD	1.303	1.243	1.301		1.260

*Scores treated as whole numbers in computations. Decimal on M and SD should be moved one place to left.

LLOYD 1-14: READING DEFICIENCY ANALYSIS OF VARIANCE RUNS

LLOYD 1-14: READING DEFICIENCY ANALYSIS OF VARIANCE RUNS - COMBINED GROUPS

J		1	2	3	Variable	TOTAL
13	N	333	1588	320	3rd CAT-Reading Total*	2241
	M	33.727	38.594	42.744		38.463
	SD	9.300	8.984	8.467		9.284
14	N	529	2487	574	6th CAT-Reading Vocabulary*	3590
	M	43.403	57.134	70.354		57.225
	SD	20.980	19.779	16.418		20.845
15	N	423	2000	420	Outcome (2=dropout, 3=graduate; transfers excluded)	2843
	M	2.686	2.734	2.807		2.738
	SD	0.480	0.456	0.418		0.456
16	N	529	2484	573	6th CAT-Reading Comprehension*	3586
	M	51.584	60.673	72.894		61.285
	SD	14.733	12.835	16.085		14.934
17	N	333	1680	353	3rd CTMM IQ Score	2366
	M	103.838	106.703	110.153		106.814
	SD	16.596	16.466	16.869		16.626
18	N	536	2537	578	6th CAT-Total Reading Total*	3651
	M	45.515	57.971	71.301		58.253
	SD	11.791	13.301	14.859		15.134
19	N	530	2510	573	6th CAT-Total Arithmetic Total*	3613
	M	56.864	60.391	63.574		60.378
	SD	8.502	8.467	8.593		8.690
20	N	528	2495	571	6th CAT-Total Language Total*	3594
	M	55.144	60.661	65.026		60.544
	SD	10.333	10.258	10.026		10.590
21	N	490	2309	508	English GPA*	3307
	M	26.763	30.114	33.406		30.123
	SD	8.183	9.241	9.587		9.325
22	N	490	2310	508	Social Studies GPA*	3308
	M	27.204	30.387	34.051		30.479
	SD	8.409	9.369	9.759		9.481
23	N	428	2060	447	Science GPA*	2935
	M	25.986	28.562	31.421		28.622
	SD	8.373	9.615	10.119		9.636
24	N	490	2309	508	Mathematics GPA*	3307
	M	26.441	29.327	32.057		29.319
	SD	8.740	9.480	10.003		9.579

*Scores treated as whole numbers in computations. Decimal on M and SD should be moved one place to left.

LLOYD 1-14: READING DEFICIENCY ANALYSIS OF VARIANCE RUNS

LLOYD 1-14: READING DEFICIENCY ANALYSIS OF VARIANCE RUNS - COMBINED GROUPS

J		1	2	3	Variable	TOTAL
	N	253	1265	263		1781
25	M	26.747	28.251	30.411	Business GPA*	28.357
	SD	9.395	10.617	11.551		10.639
	N	487	2296	505		3288
26	M	31.943	33.989	36.204	Vocational GPA*	34.026
	SD	7.614	8.492	8.655		8.472
	N	144	904	244		1292
27	M	23.771	28.346	31.574	Foreign Language GPA*	28.446
	SD	11.270	12.337	12.520		12.423
	N	485	2278	500		3263
28	M	33.930	36.622	38.440	Music GPA*	36.501
	SD	9.367	9.375	9.562		9.483
	N	464	2153	469		3086
29	M	32.463	34.149	35.531	Art GPA*	34.106
	SD	8.926	9.103	9.118		9.115
	N	486	2292	502		3280
30	M	36.245	37.345	38.843	Physical Education GPA*	37.411
	SD	7.803	8.250	7.805		8.148
	N	491	2310	509		3310
31	M	28.354	32.467	36.196	GPA (Full Unit) 7th Grade*	32.431
	SD	9.462	10.114	10.158		10.253
	N	462	2174	480		3116
32	M	27.898	31.528	35.283	GPA (Full Unit) 8th Grade*	31.568
	SD	9.441	10.289	10.972		10.473
	N	421	2061	448		2930
33	M	28.204	30.843	33.487	GPA (Full Unit) 9th Grade*	30.868
	SD	8.168	9.607	10.168		9.609
	N	391	1895	419		2705
34	M	26.189	28.366	31.212	GPA (Full Unit) 10th Grade*	28.492
	SD	8.124	9.602	10.236		9.603
	N	326	1607	360		2293
35	M	27.439	29.299	31.400	GPA (Full Unit) 11th Grade*	29.364
	SD	7.773	8.882	9.242		8.855
	N	286	1444	332		2062
36	M	29.755	31.778	33.599	GPA (Full Unit) 12th Grade*	31.790
	SD	7.546	8.038	8.338		8.086

*Scores treated as whole numbers in computations. Decimal on M and SD should be moved one place to left.

LLOYD 1-14: READING DEFICIENCY ANALYSIS OF VARIANCE RUNS

LLOYD 1-14: READING DEFICIENCY ANALYSIS OF VARIANCE RUNS - COMBINED GROUPS

J		1	2	3	Variable	TOTAL
	N	480	2256	497		3233
37	M	95.431	101.331	107.579	7th Grade Lorge-Thorndike IQ Score	101.415
	SD	14.458	15.786	17.014		16.138
	N	350	1697	368		2415
38	M	100.449	104.816	109.715	10th Grade Lorge-Thorndike IQ Score	104.930
	SD	13.742	15.041	15.865		15.196
	N	209	1114	257		1580
39	M	3.153	2.981	3.004	Cornell Medical Index (11th Grade)	3.008
	SD	1.299	1.337	1.291		1.325
	N	453	2180	483		3116
40	M	59.212	67.950	79.106	SAT Reading Average (7th Grade)*	68.409
	SD	17.520	20.588	22.326		21.175
	N	470	2196	488		3154
41	M	55.851	63.730	71.158	SAT Spelling (7th Grade)*	63.705
	SD	15.918	17.989	19.444		18.416
	N	435	2107	478		3020
42	M	52.044	62.548	71.939	SAT Language (7th Grade)*	62.522
	SD	21.246	24.127	26.059		24.660
	N	459	2166	477		3102
43	M	61.800	65.956	69.748	SAT Arithmetic Average (7th Grade)*	65.924
	SD	11.713	13.425	14.250		13.492
	N	433	2090	470		2993
44	M	58.600	65.565	73.470	SAT Average Achievement Score (7th Grade)*	65.799
	SD	13.944	16.392	17.988		16.828
	N	307	1449	320		2076
45	M	86.498	93.907	100.203	SAT Paragraph Meaning (9th Grade)*	93.782
	SD	22.390	22.217	21.963		22.511
	N	305	1448	320		2073
46	M	88.325	97.191	105.247	SAT Word Meaning (9th Grade)*	97.130
	SD	22.096	21.035	19.657		21.488
	N	306	1449	320		2075
47	M	87.268	95.475	102.728	SAT Reading Average (9th Grade)*	95.383
	SD	21.064	20.488	19.847		20.903
	N	374	1828	389		2591
48	M	10.318	12.104	13.949	ITED Social Concepts (9th Grade)*	12.123
	SD	5.051	5.459	5.679		5.522

*Scores treated as whole numbers in computations. Decimal on M and SD should be moved one place to left.

LLOYD 1-14: READING DEFICIENCY ANALYSIS OF VARIANCE RUNS

LLOYD 1-14: READING DEFICIENCY ANALYSIS OF VARIANCE RUNS - COMBINED GROUPS

J		1	2	3	Variable	TOTAL
	N	370	1821	387		2578
49	M	11.170	13.071	14.793	ITED Natural Science (General) (9th Grade)	13.057
	SD	5.872	6.047	6.150		6.115
	N	374	1829	402		2605
50	M	11.559	13.161	14.861	ITED English Expression (9th Grade)	13.193
	SD	4.613	5.116	5.771		5.231
	N	377	1825	397		2599
51	M	11.841	12.990	14.383	ITED Quantitative Thinking (9th Grade)	13.036
	SD	5.605	6.154	6.616		6.188
	N	374	1821	393		2588
52	M	11.120	13.118	15.178	ITED Social Studies Reading (9th Grade)	13.142
	SD	4.925	5.377	5.864		5.502
	N	375	1834	392		2601
53	M	10.115	11.948	13.964	ITED Natural Science Reading (9th Grade)	11.988
	SD	5.349	5.853	6.263		5.938
	N	375	1826	390		2591
54	M	9.275	11.556	13.541	ITED Literature (9th Grade)	11.525
	SD	5.246	5.668	6.182		5.805
	N	381	1816	396		2593
55	M	11.008	13.135	15.270	ITED Vocabulary (9th Grade)	13.148
	SD	5.214	5.548	5.829		5.664
	N	376	1801	389		2566
56	M	11.253	13.091	15.087	ITED Use of Information (9th Grade)	13.124
	SD	5.417	5.772	6.341		5.904
	N	536	2537	578		3651
57	M	86.832	99.843	113.573	Discrepancy Score	100.106
	SD	4.491	4.500	4.840		8.682

LLOYD 1-14: READING DEFICIENCY ANALYSIS OF VARIANCE RUNS

LLOYD 1-14: READING DEFICIENCY ANALYSIS OF VARIANCE RUNS - COMBINED GROUPS

J	SOURCE	SUM OF SQUARES	DF	MEAN SQUARE	F RATIO	OMEGA SQ
	BETWEEN GROUPS	2546.3779	2	1273.1890	25.8743	0.0134
1	WITHIN GROUPS	179505.7048	3648	49.2066		
	TOTAL	182052.0827	3650			
	BETWEEN GROUPS	106.7183	2	53.3592	17.2796	0.0093
2	WITHIN GROUPS	10730.7756	3475	3.0880		
	TOTAL	10837.4940	3477			
	BETWEEN GROUPS	26.8230	2	13.4115	5.4480	0.0025
3	WITHIN GROUPS	8584.1100	3487	2.4617		
	TOTAL	8610.9330	3489			
	BETWEEN GROUPS	29.8690	2	14.9345	3.6397	0.0014
4	WITHIN GROUPS	14968.4027	3648	4.1032		
	TOTAL	14998.2717	3650			
	BETWEEN GROUPS	78.0808	2	39.0404	14.9829	0.0081
5	WITHIN GROUPS	8929.5883	3427	2.6057		
	TOTAL	9007.6691	3429			
	BETWEEN GROUPS	48.0384	2	24.0192	17.5476	0.0095
6	WITHIN GROUPS	4729.2062	3455	1.3688		
	TOTAL	4777.2447	3457			
	BETWEEN GROUPS	5308.2206	2	2654.1103	107.2816	0.0586
7	WITHIN GROUPS	84337.4801	3409	24.7397		
	TOTAL	89645.7008	3411			
	BETWEEN GROUPS	434.6573	2	217.3286	0.7516	-0.0001
8	WITHIN GROUPS	1054798.1929	3648	289.1442		
	TOTAL	1055232.8502	3650			
	BETWEEN GROUPS	12.7637	2	6.3818	3.2071	0.0022
9	WITHIN GROUPS	3904.1951	1962	1.9899		
	TOTAL	3916.9588	1964			
	BETWEEN GROUPS	8.7066	2	4.3533	2.4502	0.0013
10	WITHIN GROUPS	3874.9784	2181	1.7767		
	TOTAL	3883.6850	2183			
	BETWEEN GROUPS	3.9585	2	1.9792	1.2384	0.0002
11	WITHIN GROUPS	3955.6735	2475	1.5983		
	TOTAL	3959.6320	2477			
	BETWEEN GROUPS	3.0012	2	1.5006	0.9446	-0.0000
12	WITHIN GROUPS	4328.8665	2725	1.5886		
	TOTAL	4331.8677	2727			

LLOYD 1-14: READING DEFICIENCY ANALYSIS OF VARIANCE RUNS

LLOYD 1-14: READING DEFICIENCY ANALYSIS OF VARIANCE RUNS - CUMBINED GROUPS

J	SOURCE	SUM OF SQUARES	DF	MEAN SQUARE	F RATIO	OMEGA SQ
	BETWEEN GROUPS	13361.0737	2	6680.5368	83.2046	0.0683
13	WITHIN GROUPS	179690.1392	2238	80.2905		
	TOTAL	193051.2129	2240			
	BETWEEN GROUPS	200025.4549	2	100012.7275	263.8950	0.1277
14	WITHIN GROUPS	1359425.5880	3587	378.9868		
	TOTAL	1559451.0429	3589			
	BETWEEN GROUPS	3.1948	2	1.5974	7.7340	0.0047
15	WITHIN GROUPS	586.5801	2840	0.2065		
	TOTAL	589.7749	2842			
	BETWEEN GROUPS	127930.3804	2	63965.1902	341.2394	0.1595
16	WITHIN GROUPS	671631.9221	3583	187.4496		
	TOTAL	799562.3026	3585			
	BETWEEN GROUPS	6905.7779	2	3452.8890	12.6143	0.0097
17	WITHIN GROUPS	646819.7677	2363	273.7282		
	TOTAL	653725.5456	2365			
	BETWEEN GROUPS	185577.8225	2	92788.9113	520.4210	0.2215
18	WITHIN GROUPS	650423.3415	3648	178.2959		
	TOTAL	836001.1641	3650			
	BETWEEN GROUPS	12397.8816	2	6198.9408	85.9575	0.0449
19	WITHIN GROUPS	260339.9058	3610	72.1163		
	TOTAL	272737.7874	3612			
	BETWEEN GROUPS	26902.9816	2	13451.4908	128.4605	0.0662
20	WITHIN GROUPS	376024.4842	3591	104.7130		
	TOTAL	402927.4658	3593			
	BETWEEN GROUPS	11004.8625	2	5502.4313	65.7648	0.0377
21	WITHIN GROUPS	276440.0471	3304	83.6683		
	TOTAL	287444.9096	3306			
	BETWEEN GROUPS	11756.9791	2	5878.4895	68.0418	0.0390
22	WITHIN GROUPS	285536.4971	3305	86.3953		
	TOTAL	297293.4761	3307			
	BETWEEN GROUPS	6482.3113	2	3241.1556	35.7315	0.0231
23	WITHIN GROUPS	265957.8931	2932	90.7087		
	TOTAL	272440.2044	2934			
	BETWEEN GROUPS	7867.8141	2	3933.9071	43.9837	0.0253
24	WITHIN GROUPS	295510.2572	3304	89.4402		
	TOTAL	303378.0714	3306			

LLOYD 1-14: READING DEFICIENCY ANALYSIS OF VARIANCE RUNS

LLOYD 1-14: READING DEFICIENCY ANALYSIS OF VARIANCE RUNS - COMBINED GROUPS

J	SOURCE	SUM OF SQUARES	DF	MEAN SQUARE	F RATIO	OMEGA SQ
25	BETWEEN GROUPS	1779.0757	2	889.5379	7.9204	0.0077
	WITHIN GROUPS	199685.5205	1778	112.3091		
	TOTAL	201464.5963	1780			
26	BETWEEN GROUPS	4512.7148	2	2256.3574	32.0281	0.0185
	WITHIN GROUPS	231426.0878	3285	70.4493		
	TOTAL	235938.8026	3287			
27	BETWEEN GROUPS	5543.4706	2	2771.7353	18.4456	0.0263
	WITHIN GROUPS	193691.7368	1289	150.2651		
	TOTAL	199235.2074	1291			
28	BETWEEN GROUPS	5119.6024	2	2559.8012	28.9566	0.0168
	WITHIN GROUPS	288208.1457	3260	88.4074		
	TOTAL	293327.7481	3262			
29	BETWEEN GROUPS	2208.2423	2	1104.1211	13.3949	0.0080
	WITHIN GROUPS	254127.3196	3083	82.4286		
	TOTAL	256335.5619	3085			
30	BETWEEN GROUPS	1699.8699	2	849.9350	12.8951	0.0072
	WITHIN GROUPS	215992.1349	3277	65.9115		
	TOTAL	217692.0049	3279			
31	BETWEEN GROUPS	15379.8268	2	7689.9134	76.4834	0.0436
	WITHIN GROUPS	332497.6913	3307	100.5436		
	TOTAL	347877.5181	3309			
32	BETWEEN GROUPS	12850.9663	2	6425.4831	60.8376	0.0370
	WITHIN GROUPS	328785.4737	3113	105.6169		
	TOTAL	341636.4400	3115			
33	BETWEEN GROUPS	6060.4669	2	3030.2334	33.5491	0.0217
	WITHIN GROUPS	264373.4174	2927	90.3223		
	TOTAL	270433.8843	2929			
34	BETWEEN GROUPS	5204.4183	2	2602.2092	28.7958	0.0201
	WITHIN GROUPS	244173.6608	2702	90.3678		
	TOTAL	249378.0791	2704			
35	BETWEEN GROUPS	2707.6330	2	1353.8165	17.5159	0.0142
	WITHIN GROUPS	176995.3003	2290	77.2905		
	TOTAL	179702.9333	2292			
36	BETWEEN GROUPS	2271.2647	2	1135.6324	17.6502	0.0159
	WITHIN GROUPS	132478.2290	2059	64.3411		
	TOTAL	134749.4937	2061			

LLOYD 1-14: READING DEFICIENCY ANALYSIS OF VARIANCE RUNS

LLOYD 1-14: READING DEFICIENCY ANALYSIS OF VARIANCE RUNS - COMBINED GROUPS

J	SOURCE	SUM OF SQUARES	DF	MEAN SQUARE	F RATIO	OMEGA SQ
37	BETWEEN GROUPS	36088.9536	2	18044.4768	72.3440	0.0423
	WITHIN GROUPS	805646.1593	3230	249.4261		
	TOTAL	841735.1129	3232			
38	BETWEEN GROUPS	15475.7805	2	7737.8902	34.4353	0.0269
	WITHIN GROUPS	541996.2526	2412	224.7082		
	TOTAL	557472.0331	2414			
39	BETWEEN GROUPS	5.2081	2	2.6041	1.4843	0.0006
	WITHIN GROUPS	2766.7007	1577	1.7544		
	TOTAL	2771.9089	1579			
40	BETWEEN GROUPS	94040.2950	2	47020.1475	112.3666	0.0667
	WITHIN GROUPS	1302644.8205	3113	418.4532		
	TOTAL	1396685.1155	3115			
41	BETWEEN GROUPS	56098.4835	2	28049.2418	87.2266	0.0518
	WITHIN GROUPS	1013259.2933	3151	321.5675		
	TOTAL	1069357.7768	3153			
42	BETWEEN GROUPS	90154.3298	2	45077.1649	77.9048	0.0485
	WITHIN GROUPS	1745693.2712	3017	578.6189		
	TOTAL	1835847.6010	3019			
43	BETWEEN GROUPS	14786.9924	2	7393.4962	41.6831	0.0256
	WITHIN GROUPS	549682.2046	3099	177.3741		
	TOTAL	564469.1970	3101			
44	BETWEEN GROUPS	50210.7707	2	25105.3854	94.1781	0.0586
	WITHIN GROUPS	797054.7428	2990	266.5735		
	TOTAL	847265.5135	2992			
45	BETWEEN GROUPS	29503.1833	2	14751.5917	29.9213	0.0271
	WITHIN GROUPS	1022016.9684	2073	493.0135		
	TOTAL	1051520.1517	2075			
46	BETWEEN GROUPS	44736.4608	2	22368.2304	50.7735	0.0458
	WITHIN GROUPS	911936.3728	2070	440.5490		
	TOTAL	956672.8336	2072			
47	BETWEEN GROUPS	37427.7060	2	18713.8530	44.6299	0.0404
	WITHIN GROUPS	868814.7036	2072	419.3121		
	TOTAL	906242.4096	2074			
48	BETWEEN GROUPS	2515.3655	2	1257.6827	42.5651	0.0311
	WITHIN GROUPS	76468.3597	2588	29.5473		
	TOTAL	78983.7252	2590			

LLOYD 1-14: READING DEFICIENCY ANALYSIS OF VARIANCE RUNS

LLOYD 1-14: READING DEFICIENCY ANALYSIS OF VARIANCE RUNS - COMBINED GROUPS

J	SOURCE	SUM OF SQUARES	DF	MEAN SQUARE	F RATIO	OMEGA SQ
	BETWEEN GROUPS	2484.1630	2	1242.0815	34.0713	0.0250
49	WITHIN GROUPS	93872.4549	2575	36.4553		
	TOTAL	96356.6179	2577			
	BETWEEN GROUPS	2118.6648	2	1059.3324	39.8656	0.0290
50	WITHIN GROUPS	69141.8242	2602	26.5726		
	TOTAL	71260.4891	2604			
	BETWEEN GROUPS	1262.6155	2	631.3078	16.6869	0.0119
51	WITHIN GROUPS	98213.0566	2596	37.8325		
	TOTAL	99475.6722	2598			
	BETWEEN GROUPS	3158.9394	2	1579.4697	54.3356	0.0396
52	WITHIN GROUPS	75142.7330	2585	29.0688		
	TOTAL	78301.6723	2587			
	BETWEEN GROUPS	2849.9579	2	1424.9790	41.6801	0.0303
53	WITHIN GROUPS	88821.6484	2598	34.1885		
	TOTAL	91671.6063	2600			
	BETWEEN GROUPS	3485.8385	2	1742.9193	53.8329	0.0392
54	WITHIN GROUPS	83790.3552	2588	32.3765		
	TOTAL	87276.1937	2590			
	BETWEEN GROUPS	3528.8251	2	1764.4126	57.3919	0.0417
55	WITHIN GROUPS	79625.0113	2590	30.7432		
	TOTAL	83153.8365	2592			
	BETWEEN GROUPS	2818.2509	2	1409.1254	41.7114	0.0308
56	WITHIN GROUPS	86585.0917	2563	33.7827		
	TOTAL	89403.3426	2565			
	BETWEEN GROUPS	199438.1819	2	99719.0909	4807.3534	0.7247
57	WITHIN GROUPS	75670.5845	3648	20.7430		
	TOTAL	275108.7664	3650			